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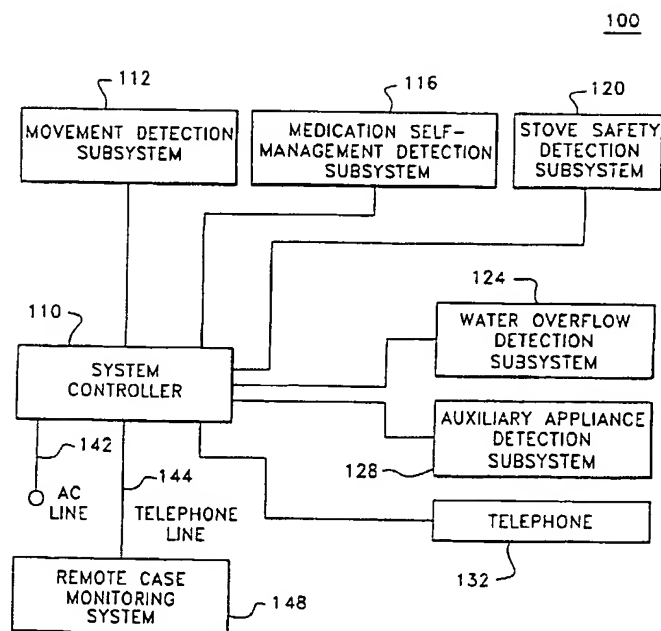
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(54) **SYSTEME DE SURVEILLANCE D'UN UTILISATEUR**

(54) **USER MONITORING SYSTEM**



(57) L'invention décrit un système (100) pour surveiller un utilisateur dans son espace de vie. Ledit système comporte une unité de commande système (110) et un sous-système de détection d'activité (112, 116, 120, 124, 128). Ledit sous-système de détection d'activité (112, 116, 120, 124, 128) surveille une activité de la vie quotidienne de l'utilisateur et fournit des informations représentatives de ladite activité à l'unité de commande

(57) A system (100) is provided for monitoring a user in a user living area. The system includes a system controller (110) and an activity detection subsystem (112, 116, 120, 124, 128). The activity detection subsystem (112, 116, 120, 124, 128) monitors a daily living activity of the user and provides information representative of the daily living activity to the system controller (110). The system controller (110) includes a





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(110). Ladite unité (110) comporte un circuit de commande qui génère un signal de commande en réponse aux informations concernant l'activité quotidienne obtenues par le sous-système de détection d'activité (112, 116, 120, 124, 128). Des ordres émanant de l'unité de commande (110) sont appliqués, au moyen d'une voie de communication d'ordres, au sous-système de détection d'activité (112, 116, 120, 124, 128) ainsi qu'à un site de télésurveillance (148). Le sous-système de détection d'activité (112, 116, 120, 124, 128) peut être un système servant à déterminer les déplacements de l'utilisateur dans la maison, à savoir si celui-ci prend bien ses médicaments, à établir l'existence de problèmes liés à l'utilisation de cuisinières ou d'autres appareils potentiellement dangereux, ou d'appareil auxiliaires sélectionnés.

control circuit which generates a control signal in response to the daily activity information obtained by the activity detection subsystem (112, 116, 120, 124, 128). Control information from the system controller (110) is applied by way of a control information communication channel both to the activity detection subsystem (112, 116, 120, 124, 128) and to a remote monitoring site (148). The activity detection subsystem (112, 116, 120, 124, 128) may be a system for determining the movement of the user around the home, medication compliance by the user, problems with usage of stoves or other potentially dangerous appliances, and selected auxiliary appliances.



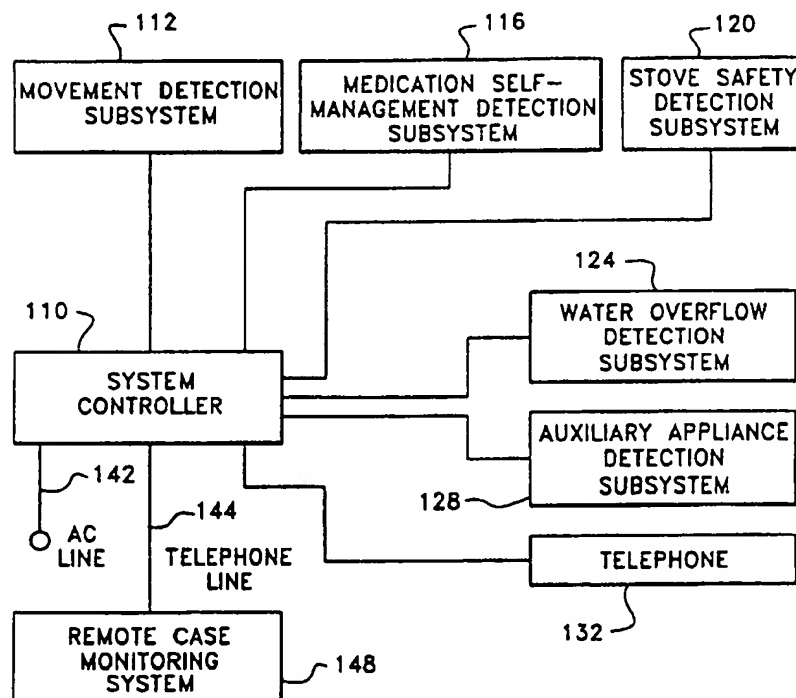
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US95/16752 <b>(22) International Filing Date:</b> 21 December 1995 (21.12.95) <b>(30) Priority Data:</b> 08/363,495      23 December 1994 (23.12.94)      US <b>(71) Applicant:</b> GEROTECH, INC. [US/US]; 205 Grandview Boulevard, Wallingford, PA 19086 (US). <b>(72) Inventors:</b> KUTZIK, David, M.; 109 W. Mount Airy Avenue, Philadelphia, PA 19119 (US). GLASCOCK, Anthony, P.; 64 Llangollen Lane, Newtown Square, PA 19073 (US). CHUTE, Douglas, L.; 314 Exeter Road, Devon, PA 19333 (US). HEWETT, Thomas, T.; 306 Martin Lane, Wallingford, PA 19086 (US). HORNUM, Barbara, G.; 4713 Cedar Avenue, Philadelphia, PA 19143 (US). <b>(74) Agent:</b> LINGUITI, Frank, M.; Reed, Smith, Shaw & McClay, 2500 One Liberty Place, 1650 Market Street, Philadelphia, PA 19103 (US).		<b>(81) Designated States:</b> AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** USER MONITORING SYSTEM**(57) Abstract**

A system (100) is provided for monitoring a user in a user living area. The system includes a system controller (110) and an activity detection subsystem (112, 116, 120, 124, 128). The activity detection subsystem (112, 116, 120, 124, 128) monitors a daily living activity of the user and provides information representative of the daily living activity to the system controller (110). The system controller (110) includes a control circuit which generates a control signal in response to the daily activity information obtained by the activity detection subsystem (112, 116, 120, 124, 128). Control information from the system controller (110) is applied by way of a control information communication channel both to the activity detection subsystem (112, 116, 120, 124, 128) and to a remote monitoring site (148). The activity detection subsystem (112, 116, 120, 124, 128) may be a system for determining the movement of the user around the home, medication compliance by the user, problems with usage of stoves or other potentially dangerous appliances, and selected auxiliary appliances.



## USER MONITORING SYSTEM

### Field of the Invention

5 The present invention relates to a system for providing in-home monitoring and intervention to assist individuals, particularly functionally impaired persons, in maintaining independent living.

### Background of the Invention

10 Several known user monitoring systems have an immediate response feature. In one prior art system if a user falls down and is unable to get up the user may push a button on a small radio frequency transmitter. This radio frequency transmitter may be worn by the user. For example, it may be worn on a necklace or on a key chain for convenience and to assure that it is available when it is needed. Pushing the button activates a device at the residence of the user which places a telephone call to a user remote monitoring site. Personnel at the remote monitoring site may listen and talk through a paging telephone in order to communicate with the user. Additionally, personnel at the user monitoring site may dispatch an ambulance or other assistance for the user.

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There is a large number of devices designed to enhance medication compliance and to monitor the extent of non-compliance. Devices available in the prior art include timers, medicament containers and combinations of timers and containers. Also available in the prior art are multiple compartment timed containers which only open at timed intervals and beep until the compartment is opened and closed. Devices available to researchers include specialized containers and bottle caps which record the date and time of opening of the container. This information is provided in a machine transferable form which may be applied to a computer for analysis of scheduling and dosing compliance.

In addition, a variety of specialized dispensers using stripped, bubble wrapped medicaments is available. These dispensers are available from pharmacists and are adapted to provide the correct pills at scheduled times and use a less expensive method for loading doses than other prior art self-loading timed dispensers. One prior art system in particular uses a host computer system to control a dispensing schedule in addition to a local timer-memory system. Another system uses color coded indicia to aid in identification of medication by users.

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Various home health monitoring systems are also known in the prior art. These systems fall into a broad category of devices which offer in-home electronic monitoring of health conditions ranging from fetal heart beat to blood pressure and blood sugar. Some of these health monitoring systems transmit a log to a central unit if a monitored parameter is outside a predetermined range. Other systems monitor predetermined health related parameters in the environment of the user.

The present invention comprises a user monitoring system for monitoring and intervening in selected activities of daily living for users requiring differing levels of monitoring or supervision. The user monitoring system monitors and provides interventions relating to four principal event domains. These event domains are (1) movement around the home, (2) medication compliance by the user, (3) problems with usage of stoves or other potentially dangerous appliances, and (4) selected auxiliary appliance control. Each of these event domains corresponds to a detection subsystem of the user monitoring system. Each detection subsystem is linked to the user monitoring system by means of radio frequency signals transmitted from subsystem sensors and received by a system controller device within the user

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monitoring system. In addition to using information obtained by monitoring the selected activities of daily living to make decisions locally, the user monitoring system produces, stores and transfers data concerning all monitored event domains and intervention activity to a remote case management system for further analysis and intervention. The remote case management monitoring system may use a knowledge base and an inference generator in order to make decisions regarding various types and degrees of intervention. The user monitoring system may provide reminders for the user to take their medications. Local and remote reprogramming of event parameters determining interventions and data recording are provided. The user monitoring system may execute controlled shutdown of the stove and other appliances as well as call the remote monitoring site in the event of possible emergencies. Data for monthly case monitoring reports which may include event logs of problem occurrences may be provided to permit cross-sectional and long-term trend analysis of difficulties. These may serve as a basis for case management decisions determining additional contacts and interventions.

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### Summary of the Invention

A system is provided for monitoring a user in a user living area. The system includes a system controller and an activity detection subsystem. The activity detection subsystem monitors a daily living activity of the user and provides information representative of the daily living activity to the system controller. The system controller includes a control circuit which generates a control signal in response to the daily living activity information obtained by the activity detection subsystem. Control information from the system controller is applied by way of a control information communication channel both to the activity detection subsystem and to a remote monitoring site.

### Brief Description of the Drawings

The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments which are presently preferred. It should be understood, however, that the invention is not



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limited to the precise arrangements and instrumentalities shown. In the drawings:

Fig. 1 is a block diagram representation of the user monitoring system of the present invention;

5 Fig. 2 is a more detailed block diagram representation of the system controller device of Fig. 1;

Fig. 3 is a block diagram representation of the movement activity detection subsystem of the user monitoring system of Fig. 1;

.0 Figs. 4A,B are side and top plan views of the medication self-management detection subsystem of the user monitoring system of Fig. 1;

Fig. 5 is a more detailed block diagram representation of the medication self-management  
5 detection subsystem of Figs. 4A,B;

Fig. 6 is a block diagram representation of the gas stove safety detection subsystem of the user monitoring system of Fig. 1;

0 Fig. 7 is a block diagram representation of the electric stove safety detection subsystem of the user monitoring system of Fig. 1;

Fig. 8 is a more detailed schematic representation of the current drain monitor of the electric stove safety detection subsystem of Fig. 7;

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Fig. 9 is a schematic representation of the water overflow detection subsystem of the user monitoring system of Fig. 1;

Fig. 10 is a block diagram representation of the auxiliary appliance detection subsystem of the user monitoring system of Fig. 1; and

Figs. 11A-11M are flow charts representing operations performed with respect to the various subsystems of the system of claim 1.

#### Detailed Description of Preferred Embodiments

Referring to the drawings, wherein the same reference numerals are used to designate the same elements throughout, there is shown in Fig. 1 a block diagram representation of a user monitoring system 100 in accordance with a preferred embodiment of the present invention. The monitoring system may be used to monitor and assist elderly persons, functionally impaired persons or the like on a temporary short-term basis or on a long-term basis. The user monitoring system 100 includes a microprocessor based system controller device 110 linked to various sensors which are provided within a number of activity detection subsystems 112-128. Activity detection subsystems 112-123 are adapted to monitor

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various activities of daily living of the user of the monitoring system 100. Also included are the in-home telephone 132 which is located within the user living area being monitored and an outside telephone line 144.

Any number of daily living activity detection subsystems may be provided within the user monitoring system 100 of the present invention. The detection subsystems provided in one embodiment may include a movement detection subsystem 112, a medication self-management detection subsystem 116, and a stove safety detection subsystem 120. However, it will be understood that using differing types of monitors, any other activities of daily living may be sensed and detected within user monitoring system 100. Additionally, the user monitoring system 100 may be coupled to a computer based case monitoring system 148 by way of a telephone line 144. Formal and informal care givers may be provided with information to determine whether short and long term intervention is required using the data transmitted to the case monitoring system 148. It will be understood that in addition to telephone line 144 or interactive television, any method of transmitting messages to system 148 may be used. For example,

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messages may be transmitted by an add-on fiber optic cable box or a portable transmitter.

The user monitoring system 100 integrates sensor data from different activity domains to make a number of determinations at predetermined times on a twenty-four hour basis. One activity domain determination within the user monitoring system 100 includes movement of the person being monitored. In this movement domain determinations are made by the movement detection subsystem 112 whether the user is up and around. The detection information which results from this determination by movement detection subsystem 112 is transmitted to the system controller device 110.

Another activity domain determination within the user monitoring system 100 is a determination of medication self-management. In this activity domain determinations are made whether the user is following a predetermined medication regimen. This determination is made by the medication self-management detection subsystem 116 of the user monitoring system 100. The detection information which results of this determination by medication self-management system 116 is also transmitted to the system controller device 110.

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Stove usage is another activity domain which is monitored by the user monitoring system 100. In this activity domain determinations are made as to whether a stove has been left on inappropriately. Detection information in accordance with this determination is transmitted to the system controller device 110. This determination may be made by differing embodiments of the stove safety detection subsystem 120 depending on whether the stove being monitored by detection subsystem 120 is a gas stove or an electric stove.

In the preferred embodiment of the user monitoring system 100 it is also possible to monitor and control other designated appliances using one or more auxiliary systems subsystems 128. These auxiliary systems may include, for example, other potentially harmful appliances such as irons or electric space heaters. System controller device 110 also receives detection information representative of the determination of the detection subsystems 116, 128.

Referring to Fig. 2, there is shown a more detailed block diagram representation of the system controller device 110 of the user monitoring system 100. The system controller device 110 includes a computer 208 and a radio frequency multichannel receiver 212. The

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computer 208 may be any type of computer capable of running C++ or any similar functionally equivalent object code. The various channels of the radio frequency receiver 212 are provided within system controller device 110 for receiving radio frequency signals transmitted from the various detection subsystems 112-128 by way of detection system antennas provided within the various detection subsystems 112-128. It will be understood that a sufficient number of information channels required to accommodate the number of detectors should be provided within system 100. These communication channels may be provided, for example, by a number of radio frequency channels within radio frequency receiver 212.

The various channels of the radio frequency receiver 212 thus serve as detection information channels for receiving detection information within the monitoring system 100. However, it will be understood that any information channel or information conduit or means for applying information may be used to apply information from detection subsystems 112-128 to system controller 110. The system controller device 110 is also provided with an AC power line transmitter 202 for applying control signals to the various detection subsystems 112-128 and to the remote monitoring site 148. Additionally,

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a system controller modem 204, and a telephone interfacing circuit 202 are present within the system controller 110.

5 In the preferred embodiment of the user monitoring system 100 the system controller device 110 may also be provided with a voice data storage device 210. The voice data storage device 210 may be used within the user monitoring system 100 to store various audio reminder and inquiry messages which may be provided  
0 to the user being monitored at predetermined times.

The power supply of the system controller device 110 of the user monitoring system 100 may include a well regulated battery with a battery backup to prevent loss of valuable user data stored in the user monitoring  
5 system 100. The radio frequency multichannel receiver 212 of the system controller device 110 is a conventional multichannel radio frequency device having appropriate anti-interference technology for preventing interference between the various subsystem channels and interference from external sources. The anti-interference technology  
may be, for example, broad spectrum modulation.

In the preferred embodiment of the system controller device 110 the radio frequency receiver 212 may be a pulsed radio frequency device. The power line

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transmitter 202 of the system controller device 110 is a conventional system for turning controlled appliances on and off. In the preferred embodiment of the user monitoring system 100, this control may be accomplished by sending pulsed radio frequency signals through the AC lines of the living areas of the user as understood by those skilled in the art. The use of different pulsed signals, decodable by different detection subsystems, is effective to provide any required number of control information channels for applying control signals to detection subsystems 112-128 by system controller 110. However, it will be understood that the transmission of control information from the system controller device 110 to the various detection subsystems 112-128 may be performed by any suitable information channels.

The controller modem 204 of the system controller device 110 may be a conventional modem capable of providing known incoming and outgoing modem protocols. The outgoing protocols of the controller modem 204 may be used for data transfer from the system controller device 110 to the case monitoring site 148 or to other locations by way of telephone line 144. The incoming protocols of the system controller modem 204 may be used for reprogramming various monitoring and intervention



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parameters of the user monitoring system 100.

Reprogramming may be performed either by the remote case monitoring site 148 through the controller modem 204 or directly to the system controller device 110.

5 Additionally, the incoming protocols may be used for any type of communication with the user monitoring system 100.

The local telephone interface circuit 206 of the system controller device 110 provides several functions within the user monitoring system 100. It transmits incoming calls received by the user monitoring system 100 by way of the telephone line 144 to the in-home telephone 132. The telephone interface device 206 also connects ringing voltage as well as synthesized voice messages from the voice data storage device 210 to the in-house telephone 132 on command to provide messages to the user by way of the in-home telephone 132. It also makes several determinations regarding the state of the in-house telephone 132. For example, determinations when the in-home telephone 132 is off-hook, when the in-home telephone 132 is not off-hook, and whether the number one has been pressed on the in-home telephone 132 may be made by the local telephone interface circuit 206.

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5 The user monitoring system 100 operates in a home mode and in an away mode. The away mode of the user monitoring system 100 may be selected by pressing a dedicated away switch (not shown) located in a convenient location in the home of the user. Additionally, the away mode of user monitoring system 100 may be remotely set from the case management monitoring host site 148. The home mode of the user monitoring system 100 may be passively set, for example, by the opening of a door when the user returns home.

3 In the preferred embodiment of the system controller device 110, a reprogrammable microprocessor receives detection information, makes determinations as set forth herein, and provides control information accordingly. However, it will be understood by those skilled in the art that any type of control circuitry capable of performing the operations set forth herein may be used within the user monitoring system 100.

1 Referring to Fig. 3, there is shown a block diagram representation of a preferred embodiment of the movement activity detection subsystem 112 of the user monitoring system 100. Within the user monitoring system 100, movement sensed by the movement activity detection

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subsystem 112 is assumed to indicate that the user being monitored is up and around.

It will be understood by those skilled in the art that the configuration of the movement detection subsystem 112 may vary according to the differing living areas being monitored by user monitoring system 100.

However, in general the movement detection subsystem 112 includes at least one and preferably several motion sensors such as motion sensor 304 positioned at spaced locations within the home of the user or a conventional reed switch door opening such as sensor detector 308.

The motion sensor 304 and the reed switch 308 are provided for determining whether there is movement or activity within the living area being monitored by the user monitoring system 100.

In the most basic embodiment of the detection subsystem 112, only a single motion sensor 304 may be provided. In this case the single motion sensor 304 is preferably placed between the bed of the user and the bathroom. In a case where only a single reed switch is provided within the movement detection subsystem 112, it is preferably placed on the door of the bathroom. Such basic configurations of the movement detection subsystem 116 are effective to determine whether the user being

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monitored has gotten out of bed or has gone to the bathroom after a predetermined time.

When an activity is sensed by the motion sensor 304 or the door opening sensor 308, a motion transmitter 306 of the motion detection subsystem 112 transmits a radio frequency signal by way of the motion antenna 302. This motion signal representing an activity of daily living by the user is received by the system controller device 110 of the user monitoring system 100. It is therefore activity of daily living information which indicates that the detected user movement has occurred within the home being monitored by the user monitoring system 100.

Similarly, a conventional reed switch (not shown) or other type of switch within the door opening sensor 308 is provided with a radio frequency door opening transmitter 312. The door opening transmitter 312 transmits a door opening signal indicating the opening of a door or cabinet to which the sensor 308 is applied. The door opening signal is transmitted by detection subsystem 112 is a radio frequency signal representative of this activity. It is transmitted to the system controller device 110 by way of the motion detection antenna 310.

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5 If the dwelling being monitored is large or complex a more elaborate configuration of movement and activity sensors 304, 308 may be required within the movement detection subsystem 112 of the user monitoring system 100. However, in the preferred embodiment of the user monitoring system 100 at least movement from the bed and movement into and out of the bathroom should be monitored by the movement detection subsystem 112. Inappropriate periods of user inactivity as indicated by sensors 304, 308 or other sensor disposed in these locations may indicate a medical emergency. It will be understood that a plurality of motion sensors or switches such as reed switches may be placed in locations within the living area being monitored and that there are no theoretical limitations in the number of such devices which may be used with the movement detection system 112.

5 When the movement detection subsystem 112 operates in the home mode the user monitoring system 100 is in a twenty-four hour cycle. This twenty-four hour cycle includes information with respect to the usual waking time of the user being monitored. Using the motion sensors 304, 308 of the motion detection subsystem 112 the user monitoring system 100 determines if the user remains in bed a specified length of time beyond the

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usual waking time or has not gone from the bed to the bathroom for a predetermined time period. If the user monitoring system 100 determines an abnormal lack of user activity such as this it may enter a wake up monitor phase.

In the wake up monitor phase of the user monitoring system 100 the system controller device 110 may place a telephone call to the user by way of the telephone 132 in order to determine whether the user is having a problem. If the telephone call placed by the system controller device 110 is answered, the user is prompted by the system controller device 110 to depress a predetermined key on the in-home telephone 132. For example, the user may be prompted to press the telephone key indicating the number one. If the user complies with the prompt from the system controller device 110 the wake up monitor phase of the user monitoring system 100 is complete. If there is no answer to the call placed by the system controller device 110 and the user monitoring system 100 is not in away mode, or if the user answers the telephone but does not depress the requested key, the user monitoring system 100 contacts the case monitoring site 148 with an immediate status report indicating a potential problem with the user.

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Assuming all is well, the activity movement detection subsystem 112 of the user monitoring system 100 merely monitors all system status changes within system 100. This includes monitoring and storing information from the motion detectors 304, 308 representing movement and the opening and closing of doors, the usage of medication, the usage of the stove and appliances, and any other auxiliary devices which may be monitored by the user monitoring system 100.

Each status change detected by the user monitoring system 100 is assumed to indicate activity of the user being monitored. In the event of the detection of a period of inactivity in excess of a predetermined amount of time during the usual waking hours of the user, the user monitoring system 100 returns to the wake up monitor phase and places a telephone call to the user as previously described. The period of inactivity required for the user monitoring system 100 to return to the wake up monitor phase is adjustable depending upon the habits of a particular user but may, for example, be two and one-half hours.

When the user monitoring system 100 is in the away mode it does not record or report any activities. It merely waits for active or passive resetting of the

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home mode as previously described. Active resetting of the home mode of the user monitoring system 100 occurs when the user activates a dedicated home/away switch which may be mounted at any convenient location. Passive resetting of the mode of the user monitoring system 100 may occur when the user returns and changes the status of any detection subsystem 112-128.

Referring to Figs. 4A,B, and 5, there are shown a side view, a top plan view, and a schematic representation of a preferred embodiment of the medication self-management detection subsystem 116 of the user monitoring system 100 of the present invention. The medication self-management detection subsystem 116 comprises a medication holder 404 which is a specialized portable holder or caddy for holding at least one medication container 402 in a corresponding container opening 404.

In the preferred embodiment of the medication detection subsystem 116 a plurality of the medication containers 402 may be installed within their corresponding container openings 406 in the portable medication holder 404 when the user being monitored is not removing medication from them. The medication containers 402 and the container openings 406 within the



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medication holder 404 may be color coded. In this method the colors of a selected medication container 402 and its container opening 406 match each other. Likewise, each container opening 406 of the medication holder 404 may be provided with a matching colored light 408. The colored lights 408 assist the user in returning a removed medication container 402 to its correct container opening 406.

When a medication container 402 is disposed within a container opening 406 of the medication holder 404 the medication container 402 closes a conventional normally open switch 416. When the medication container 402 is removed from the opening 406 of the medication holder 404 it releases the normally open switch 416 causing it to open. When a switch 416 within the medication holder 404 is opened or closed in this manner by a medication container 402 a radio frequency medication transmitter 424 is activated. In this manner the medication self-management detection system 116 communicates this activity of daily living information with the system controller device 110.

The radio frequency signal provided by the medication transmitter 424 when it is activated by a switch 416 is pulse code modulated by pulse coder 420.

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The modulating of the pulse coder 420 is performed in a series of differing manners according to which switch 416 within the medication container 404 is opened. The selected pulse coded signal from the medication transmitter 424 is received, decoded, and stored by the system controller device 110 of the user monitoring system 100.

While the medication container 402 is removed from the medication holder 404 its matching colored light 408 is activated. This causes the color code of the medication container 402 removed from the medication holder 404 to be displayed as previously described. When the medication container 402 is replaced in its opening 406 of the medication holder 404 and the transmitter 424 is activated to transmit a corresponding pulse code modulated signal, the colored light 408 turns off and the transmission from the medication transmitter 424 to the system controller device 110 terminates. The termination of the transmission by the medication transmitter 424 indicates to the system controller device 110 that the medication container 402 has been returned to its opening 406 in the medication holder 404.

It will be understood by those skilled in the art that any number of medication openings 406 may be

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provided within a container holder 404 of the medication self-management detection subsystem 116. However, it is believed from current research that the daily medication management needs of a majority of users of the user monitoring system 100 may be met by eight medication openings 406 and eight corresponding medication containers 402 although only three are shown in order to simplify the drawings. It will also be understood that the openings 406 of the container holder 404 and the medication containers 402 may be provided with keying features so that only the correct medication container 402 may be placed into an opening 406 of the medication holder 404.

While the above describes many of the features of a preferred embodiment of the medication self-management detection system 116, it should be noted that various arrangements of medication holders and dispensers may be used. For example, the medications within a medication holder 404 may be organized according to the time of day they are taken. In this type of organization medications which are taken at the same time may be loaded together into a single compartment within the medication holder 404. A plurality of these compartments may be provided within the medication self-management

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detection system 116. The opening and closing of these compartments may be monitored by the medication self-management detection system 116 in substantially the same manner as previously described with respect to monitoring the removal of the medication containers 402 from the openings of the medication holder 404.

As previously described the pulsed transmissions from the medication transmitter 424 to the system controller device 110 may carry a plurality of differing codes corresponding to the plurality of differing medication containers 402. Each pulse code corresponds to an individual medication container 402 and indicates when its corresponding medication container 402 is currently removed from the medication holder 404.

The system controller device 110 of the user monitoring system 100 is programmed to record the times of removal and replacement of each medication container 402 within medicine holder 404 according to these transmissions. It is also programmed to determine scheduled on-time removals of each of the medication containers 404 from the medicine holder 404. Compliance data representative of these determinations according to transmissions from the medication self-management

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detection system 116 may be transferred to the case monitoring site 148 for intervention decisions.

5 The system controller device 110 of the user monitoring system 100 may be programmed to determine when user compliance does not conform to a scheduled regimen. After a selected time period, for example, one-half hour, without user compliance, voice data from the voice data storage device 224 may be applied by the controller device 110 to the in-home telephone 132 to remind the user to take medications. The system controller device 10 110 may also provide general and specific reminders and inquiries to the user concerning medications after the user returns from being away. These reminders and inquiries may be made with respect to all medications or with respect to specific medications. The system 15 controller device 110 may also provide specific time scheduled reminders to take medication.

10 Referring to Figs. 6, 7, there are shown two embodiments of the stove safety detection subsystem 120, the stove safety detection subsystem 600 and an electric stove safety detection subsystem 700. The stove safety detection systems 600, 700 of Figs. 6, 7 are preferred alternate embodiments which are adapted for monitoring

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and controlling gas stoves and electric stoves, respectively.

5 The stove safety detection subsystems 600, 700 of the user monitoring system 100 each include an appropriate stove-in-use sensor for determining when a monitored stove is turned on. Each stove safety detection subsystem 600, 700 also includes an appropriate shut-off receiver unit for receiving a radio frequency transmission from the system controller device 110 by way of the AC lines to turn the monitored stove off and protect the user. The stove-in-use sensors of the stove safety detection subsystems 600, 700 continuously provide information to the system controller device 110 of the user monitoring system 100 regarding whether the monitored stove is currently on.

5 The stove-in-use sensor 604 of the gas stove safety detection subsystem 600 is a gas flow monitor 604. The gas flow monitor 604 is disposed in the gas line 602 which supplies gas to the gas stove 610 in order to monitor the gas supplied by the gas line 602 to the gas stove 610. Gas flow information from the gas flow monitor 604 is pulse coded by a pulse coder 612. The coded signal from the pulse coder 612 is transmitted to

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the system controller device 110 by a gas stove transmitter 620 by way of the gas stove antenna 616.

5 The system controller device 110 may determine that the gas stove 610 must be shut off in accordance with the coded information from the gas flow monitor 604. If this determination is made by the system controller device, it applies a control signal to the gas stove safety detection subsystem 600 by way of the AC line 630. The control signal to the gas stove detection system 600 from the system controller device 110 is generated and transmitted by way of the AC power line transmitter 216 as previously described. This control signal is received by the controller receiver 628 of the gas stove safety detection subsystem 600. The controller receiver 628 instructs a gas shut off valve 608 by way of a step down circuit 608 to terminate gas flow through gas line 602 to the gas stove 610 in response to the control signal. This turns off the gas stove 610.

0 When the user monitoring system 100 monitors an electric stove 710, an electrical current draw monitoring device 704 is provided for use along with the electric stove safety detection system 700. The electrical current monitoring device 704 is applied to the AC power line 706 which supplies power to the electrical stove

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710. By monitoring the AC power line 706 detector subsystem 700 is able to indicate the on/off status of the burners of the electric stove 710. On/off status information is coded by the pulse coder 712 and transmitted by an electric stove transmitter 720 by way of antenna 716 to the system controller device 110.

The system controller device 110 may determine that the electric stove 710 must be shut off in accordance with the coded information from the current draw monitor 704 as previously described with respect to the gas stove safety detection system 600. If electric stove 710 is to be shut off, the system controller device 110 applies a control signal to the electric stove safety detection subsystem 700 by way of the AC line 730. This signal is received by a controller receiver 728 of the electric stove safety detection subsystem 700. The controller receiver 728 instructs the electrical trip relay 708 to interrupt electricity through the electrical power supply line 702 to electrical stove 710. This turns electric stove 710 off.

When the stove safety detection subsystems 600, 700 provide information indicating that a stove is on, shut down predetermined control algorithms are followed in order to determine whether the stove 610, 710 should



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be turned off. These predetermined control algorithms are executed within the system controller device 110 of the user monitoring system 100. In the preferred embodiment of the user monitoring system 100 the algorithms operate upon coded information transmitted from the stove safety detection management subsystems 600, 700 and the movement detection subsystem 112 in the following manner although the other algorithms may be used if desired:

If (no movement detected for 30 minutes) or (away-mode status) and stove-on status), then (call with stove reminder).

If (no answer to call), then initiate shut down and record event. If (call is answered and 1 is pressed), override shut down.

If (stove on status) and (smoke detector tripped), then initiate shut down and record event.

If (stove is on for [X] minutes), then alert remote site host with automated telephone message: "Your stove is on, do you want it on? If yes, press 1; otherwise, it will be turned off." Answering the telephone and pressing 1 override the shut-down sequence.

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5                    Additionally, management subsystems 600, 700  
may include smoke detector sensor devices 632, 732  
coupled to radio frequency transmitters 620, 720. The  
smoke detection sensor devices 632, 732 may be standard  
optical smoke detector modified to include a subsystem  
switching circuit (not shown) which is effective to  
provide a smoke detect control signal when smoke is  
detected by the sensor devices 632, 732. The radio  
frequency transmitters 620, 720 of the smoke detection  
subsystem is coupled to the subsystem switching circuit  
of the smoke detection sensor devices 632, 732 in a  
manner well understood by those skilled in the art.

5                    When the sensor devices 632, 732 detect smoke  
within the home of the user they sound a fire alarm in a  
conventional manner. Additionally, the detection of  
smoke by the sensor devices 632, 732 activates subsystem  
switching circuit which activates the respective smoke  
detector transmitter 620, 720. In response the smoke  
detection transmitters 620, 720 provide a pulsed radio  
frequency control signal by way of the antenna 616. This  
control signal conveys information to the system  
controller device 110 of the user monitoring system 100.  
The information transmitted by the subsystems 600, 700 in  
this manner indicates to the system controller device 110

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that smoke was detected by a sensor device 632, 732. It may also indicate which particular sensor device is triggered if more than one sensor device 632, 732 is used within a subsystem 600, 700.

5 Referring to Fig. 8, there is shown a more detailed schematic representation of the current draw monitor 704 of the electric stove detection subsystem 700. The current drain monitor 704 may include a passive clamp coil 730 disposed around the electrical supply line 0 706 which applies electrical energy to the electric stove 710. Electromagnetic fields arising from the current applied to the stove 710 by way of the electrical supply line 706 thus induce current in the passive clamp coil 730. The current induced in the passive clamp coil 730 may be rectified by a bridge rectifier 734, amplified by 5 an amplifier 738, and applied to a diode switch 742. The diode switch 742 may then control the gate of silicon control regulator 746 to apply energy to the pulse coder 712.

0 It will be understood that any method may be used for sensing the electromagnetic fields arising from the current applied to the stove by way of the electrical supply line which induces current in the passive clamp coil 730, provided the current induced in the passive

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clamp coil is used to toggle an electronic switch of suitable design to control a pulsed radio frequency signal indicating to the system controller the on/off state of the stove 710. Additionally, it will be understood by those skilled in the art that pulse code 710 may be controlled by any other means for determining the state of stove 710.

Referring to Fig. 9, there is shown a preferred embodiment of the water overflow detection subsystem 124 of the user monitoring system 100. The water overflow detection subsystem 124 may be installed on plumbing fixtures such as sinks and bathtubs within the home of the user being monitored by the user monitoring system 100. Within the water overflow detection subsystem 124 a water level sensing device 1004 and a remote controlled shut-off device 1030 are provided in communication with the system controller device 110 of the user monitoring system 100.

In the principles of its operation, the water overflow detection subsystem 124 is similar to the gas stove safety subsystem 600 previously described. The water level sensing device 1004 or water level monitor 1004 sends information to the system controller device 110 by means of a pulsed radio frequency water level

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transmitter 1002. The system controller device 110 is programmed to initiate shut off of water within overflow detection subsystem 124 by means of a radio frequency remote control signal. The radio frequency remote control signal is transmitted through the home of the user by way of the AC lines.

The control signal from the system controller device 110 is received by the controller receiver 1044, stepped down by step down circuit 1040. The stepped down signal is used to control resetable electrically controlled water valves 1034, 1038. The electrically controlled valve 1034 may control water flow from an inlet pipe 1026 to a tub supply pipe 1028. The electronically controlled valve 1038 may control water flow from an inlet pipe 1026 to a sink inlet pipe 1032.

The water level sensing device 1004 includes two water level detectors 1006, 1012, and a siren module 1018 having a conventional timer. A siren transducer such as a piezoelectric crystal is also provided. A three-state pulsed radio frequency transmitter 1002 may be provided within the water overflow detection subsystem 124.

When water is sensed at a warning level by the level detector 1006 the system controller device 110 of

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the user monitoring system 100 is informed that water is approaching the warning level mark. When this is detected the user monitoring system 100 calls the user on the in-home telephone 132 in order to provide a reminder. When the level detector 1012 determines that the water level has approached the high water mark, the siren 1024 sounds. Additionally, the received radio frequency pulse data informs the system controller device 110 of the user monitoring system 100 to turn the water off. This event is logged within the system controller device 110. The water overflow detection subsystem 124 may be programmed to permit resetting of the valves 1034, 1038 in response to commands from within user monitoring system 100 or from the case monitoring site 148.

Referring to Fig. 10, there is shown a block diagram representation of the auxiliary appliance detection subsystem 128 of the user monitoring system 100. The auxiliary appliance detection subsystem 128 provides additional channels to the user monitoring system 100 for monitoring and controlling further appliances 1116 or devices 1116.

The on/off state of the further device 1116 is monitored and transmitted to the system controller device 110 of the user monitoring system 100 by means of a

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current draw detector 1108. The current draw detector 1108 monitors current applied to the device 1116 by way of the AC power supply line 1114. The current draw detector 1108 is coupled to a radio frequency auxiliary transmitter 1112 which transmits a two state signal representing on and off. This information may be used by the system controller device 110 both for status change data and for generating a daily activity data log. The current draw sensor 1108 of the auxiliary detection subsystem 128 should be sufficiently sensitive to distinguish between trickle draw and operational power when auxiliary device 1116 is a solid state device such as a television or a clock radio.

In addition to the monitoring of the use of a auxiliary device 1116, automatic remote control of the device 1116 may be accomplished. The system controller device 110 of the user monitoring system 100 may be programmed to control a controlled outlet or receptacle adapter which applies energy to the AC line 1114. This control may be exercised at predetermined times of the day or upon certain environmental occurrences. For example, when the user monitoring system 100 is in the away mode this feature may be used to automatically turn the auxiliary appliance 1116 off. More than one

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auxiliary subsystem 128 may be provided within the user monitoring system 100.

Furthermore, monitoring system 100 may be provided with an auxiliary detection system which is not monitored by a current draw monitor 1108 or controller receiver 1104. For example, the multichannel receiver 212 of system controller 110 may be used to monitor smoke detection subsystem 900 shown in Fig. 9.

It will be understood that many differing combinations of auxiliary detection subsystems may be provided within the user monitoring system 100 of the present invention. It will also be understood that these combinations may be used in combination with automated dialing systems at other locations. Automated dialing systems which may call the dwellings of various users, for example, one or more times a day have been developed. This provides the user with an opportunity to return a predetermined signal if there are no problems and return a different predetermined signal or no signal if there are problems.

These services may give users up to six automated contacts per day. For example, an automated dialing system for providing medication compliance reminders, suitable for use with the user monitoring



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system 100, has been field tested. In this automated reminder system users were called daily and reminded to follow their medication regimen.

Referring to Figs. 11A-11M, there are shown  
5 flow chart representations of the operations of the various subsystems of the user monitor system 100.

Fig. 11A is a flow chart representation of a method for determining which of the various subsystems has initiated an event for processing by the controller 110. Fig. 11B  
10 is a flow chart representation of a method for determining whether the user has arisen by a designated wake up time. This method may be performed in response, for example, to a signal from the motion sensor 304.

Fig. 11C is a representation of a method for determining  
15 whether the user is complying with the medication schedule as indicated by the subsystem 116.

Fig. 11D is a representation of methods for determining whether a stove has been left on according to the subsystem 600 and whether the smoke detector 732 has  
20 been activated. Fig. 11E is a flow chart representation of a method for turning off the stove 610, 710. Fig. 11F is a flow chart representation of a method for controlling water flow according to the subsystem 124. A

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pseudocode representation of a method for controlling water flow is set forth in Table I.

```

5      Is there a flow
        If yes
          Is there a change of state
            If yes
              send event to main controller
            If no
              recycle to flow monitor
10     If no
          Is there a change of state
            If yes
              send event to main controller
            If no
15         recycle to flow monitor

        Is there water overflow
          If yes
            Send event to main controller
          If no
20         Is there water warning
              If yes
                send event to main controller
              If no
                recycle to water overflow
25
        Table I
  
```

Fig. 11G is a flow chart representation of a method for alerting a user that an appliance has been left on, for example, in accordance with the bridge rectifier 734. Fig. 11H shows a method for calling a designated party when an alert has been determined. Fig. 11I shows a method for recording the detection of movement, for example, in response to a signal from the motion sensor 304.

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Fig. 11J is a flow chart representation of a method for reading switches within the user monitoring system 100. A pseudocode representation of a method for reading switches is set forth in Table II.

```

5      Is the switch open
      If yes
          Is there a state change
          If yes
              send event to controller
              turn off light
10         If no
              recycle to open test
      If no
          Is there a state change
15         If yes
              send event to main controller
              turn on light
          If no
              recycle to open test
20
      Table II

```

Fig. 11K is a flow chart representation of an algorithm for determining either current flow or gas flow. Fig. 11L is a flow chart representation of an algorithm for detecting water overflow. Fig. 11M is a flow chart representation of an algorithm for controlling an auxillary appliance. A pseudocode representation of this method is set forth in Table III.

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```

Is the automatic timer set
  If yes
    Is there current draw
      If yes
        Is turn off timer exceeded
          If yes
            turn off appliance
            send event to controller
          If no
            recycle to AT set
        If no
          Is turn on time exceeded
            If yes
              turn on appliance
              send event to controller
            If no
              recycle to AT set
      If no
        Is there current draw
          If yes
            Is there a state change
              If yes
                send event to main
                controller
              If no
                recycle to AT set
            If no
              Is there a state change
                If yes
                  send event to main
                  controller
                If no
                  recycle to AT set

```

Table III

35           As previously described, using the  
 microprocessor based system controller device 110 and a  
 system of sensors the user monitoring system 100 can  
 determine, for example, whether users are up and about in  
 their homes and whether they are having difficulty  
 40 managing their medications. It can also be determined

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whether the user has accidentally left a stove on or has failed to get out of bed a predetermined number of hours after a usual waking time. If the user monitoring system 100 detects any of these or other problems it can then call the user on the in-home telephone 132 to provide a reminder about the medications, stove, or other detected problems.

Using this data from the user monitoring system 100, the remote case monitoring system 148 may provide on-line case monitoring of each user by receiving standard information and information designated as priority information and analyzing the received information. In order to do this, the remote case monitoring system 148 converts incoming data on each user into various summary reports which track the activities of the client. This makes it possible to distribute specialized gerontological every day living summary reports to users, family members, case managers, physicians and others. It also makes it possible to collect and act upon the designated priority information which may indicate immediate problems for the user. For example when a user appears not to have gotten out of bed a problem may be indicated.

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5                   Additionally, the collection of this kind of  
data by the remote case monitoring system 148 may provide  
an aggregate data base for identifying which users  
require personal interventions and which do not. In  
10                   order to perform these functions the remote case  
monitoring system 148 serves as a central hub for the  
collection, analysis and exchange of information which  
has direct case management import. It should be  
understood that in different embodiments of the inventive  
15                   concept different degrees of autonomy of the local system  
controller 110 in relation to the remote system 148 are  
possible. In one embodiment a local system controller  
110 may be programmed to perform many functions performed  
by the remote case monitoring system 148 in another  
embodiment.

                  For example the dialing and sending of voice  
messages to a list of relatives and providers may be  
performed either by the local system controller 110 or  
the remote case monitoring system 148. However, it will  
20                   be understood that the primary function of the local  
system controller 110 is to provide lower level case  
management of local observations and decisions and the  
primary function of the remote case monitoring system 148  
is to provide higher level case management to enable long

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term interpretation of the data obtained from the user monitor system 100 and intervention in view of the long-term interpretation.

Thus in the preferred embodiment of the present invention, the user monitoring system 100 or the remote case management system 148 may use its electronic records to enable the production of scheduled periodic user activity reports based upon information gathered by the various subsystems of the user monitoring system 100. These periodic reports may include collections, compilations and arrangements of information on any or all of the monitored activities within the user's living area. These electronic records may be used in combination with any other information to produce any type of periodic activity reports desired on the user being monitored. These user activity reports may be used by a professional case manager or a designated family member to determine if the user is experiencing problems with specific activities of daily living. Thus these problems may be dealt with before they become a threat to the continued well being of the user and the ability of the user to live independently.

Furthermore, in addition to providing remote case monitoring and in-home reminders, the user

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monitoring system 100 may be programmed to take corrective actions when certain problems are detected. For example, if the user being monitored has not gotten out of bed by a predetermined time the user monitoring system 100 may call the user on the telephone 132. If there is no answer to the telephone call the user monitoring system 100 may be programmed to automatically transmit this information to the remote case monitoring site 148.

A social worker, health professional or designated family member at the remote case monitoring site 148 may respond to the transmitted information according to a predetermined protocol. In addition to transmitting the information to the remote case monitoring site 148 the user monitoring system 100 may provide control signals within the home of the user. For example, if the user monitoring system 100 of the present invention determines that a stove has been left on, the user monitoring system 100 itself can turn off the stove.

The remote case monitoring system 148, in association with the user monitoring system 100, may serve the functions of a case management site. In an example of the case management site function of the remote case monitoring system 148 the case management



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site may monitor approximately fifty distributed clients, each using a distributed user electronic monitoring system 100. The fifty clients thus have the system controller 110 and various subsystem sensors installed in their dwellings in ways appropriate for the specific configuration of their living areas. For example, the various subsystem sensors must be adapted for different floor plans and furniture arrangements.

The remote case monitoring system 148 may receive information from the distributed user monitoring systems 100 on an immediate basis or at predetermined time intervals. For example, the remote case monitoring system 148 may receive information hourly, daily or weekly basis. If one of the clients does not get out of bed within a predetermined time duration and does not answer the telephone, the local system controller 110 of the user monitoring system 100 at that client's house may call the case management site. At the case management site, this event may be brought to the immediate attention of the human case monitor, for example, by means of a computer screen. The remote case manager may examine individual case and data records for the client being monitored to learn the predetermined response for the monitored person when the reported event occurs.

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Likely interventions required of personnel at the case management site may include calling a local case manager, a hospital social worker or a local next of kin. Other actions the remote case monitor may execute include calling the user, remotely downloading the last twenty-four or forty-eight hours worth of event summary information from the local user monitoring system 100 and remotely initiating a diagnostic sequence on the local user monitoring system 100.

The protocol of procedures for intervention by the remote case monitor 148 may differ from one remote case monitoring system 148 to another and from one user to another. It is anticipated in the preferred embodiment of the invention that various intervention decisions such as who to call when predetermined events occur and what messages to deliver may be carried out by a machine intelligence expert system (not shown) at the remote case monitoring system 148 or by a person or a combination of both. The local user monitoring system 100 may also be programmed to carry out such decisions as who to call when appropriate. For example, the user monitoring system 100 may have a contact list of people to contact in various emergencies.

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In addition to receiving and interpreting data indicating the need for intervention in event of emergencies, the remote case monitoring system 148 routinely receives downloaded data from individual user monitoring systems 100 at predetermined intervals. This data is interpreted on the individual and aggregate level by means of trend analysis software which detects larger than statistically normal deviations from event pattern measurements. The remote case monitoring system 148 may use this analysis to produce periodic summary reports of events relating to everyday living tasks in the home environment of the user. More specifically these reports may be used to detect certain event classes, to weight them in terms of their relative importance and to compare them with baselines of task performance. The events weighed with respect to their importance may include getting out of bed, managing medication, the proper control of a stove, the proper control of water flow, and the proper control of selected electrical appliances. Based upon the reports of these events, gerontological living summary reports may be prepared in machine form and paper form at the remote case management system 148 for distribution to predesignated parties involved in the case management of the user of the user monitoring system

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100. These parties may include the users themselves, relatives of the user, case manager social workers, physicians and other appropriate formal and informal providers.

5           Two additional functions of the remote case monitoring system 148 may be provided. These functions are: (1) the remote programming and reprogramming of the user monitoring system 100, and (2) the generation of aggregate and individual level data on relatively large  
10 numbers of users. This data may serve both as an empirically grounded knowledge base driving the decision protocols for both humans and machines as well as research data for further development of the user monitoring system 100.

15           In order for these functions to be performed data must be transmitted between the user monitoring system 100 and the remote case monitoring system 148. Information transmitted to the system controller 110 of the local user monitoring system 100 from the remote case  
20 monitoring system 148 may include three different types of commands: queries, diagnostics and settings. The query commands request the downloading of specific information from the memory of the user monitoring system 100 to the remote case monitoring system 148. The

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requested information forms the basis of the gerontological everyday living events report along with specific information necessary for case monitoring by the remote system 148. For example the status of different subsystems of the user monitoring system 100 might be made available to the remote system 148 when the motion subsystem 112 indicates that the user has not gotten up in the morning.

The diagnostic commands to the local user monitoring system 100 test the different subsystems of the system 100 by suppressing the ability of the system 100 to either call out interventions or change settings on any of the remotely controlled devices while at the same time initiating a sequence of event codes which indicate the presence of various kinds of problems as if they were indicated by the different subsystems.

The setting commands from the remote case management system 148 to the user monitoring system 100 reset the parameters on the timers within the user monitoring system 100 as well as other variable values for the decisions made in the decision trees described hereinbelow. These parameters may include, but are not limited to, the time of waking up, the times for taking

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different medications and the length of time which should elapse prior to turning off the stove.

Transfer information transmitted in the opposite direction, from the system controller 110 of the user monitor system 100 to the remote case monitoring system 148, includes two types: (1) priority specific data transfer and (2) standard data transfer. Priority specific data transfer is initiated by the local system controller 110 by means of dialing the remote case monitoring system 148 by way of the telephone line 144 or by means of another data link (not shown) and indicating the presence of a problem which the remote case monitoring system 148 must detect, record and act upon.

Situations in which the local system controller 110 dials out to inform the remote case monitoring system 148 that the user did not get out of bed or that the stove was left on, are potential emergencies and are therefore examples of priority specific data transfer. Standard data transfer includes the downloading of event log information for each subsystem. This information is used to produce trend analysis reports which show the frequency of occurrence of different events over a predetermined time period such as six months. Thus the trend analysis report might show that over the course of

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six months the user became increasingly noncompliant with medications and/or increasingly likely to leave the stove on inappropriately. Using a known trend analysis technique, software driven reports can detect increasing frequencies of problems of every day activities.

The trend analysis report may be a monthly paper or machine report which provides several indicators of performance on different areas of everyday living monitored by the user monitoring system 100. These areas may include waking and sleeping, medication management, stove management, water flow management and the operation of additional appliances. The raw data for this report is based on the event log data transferred from the local system controller 110 remote system using standard data transfer and priority specific modes. The raw data is used to provide a continuous baseline of the successful and not successful completion of the five task areas.

For example, in one month a user may use the stove fifty-five times and leave it on in violation of the programmed protocol two times. The monthly report line for the stove category might then show fifty-five uses and two usage errors. Furthermore, usage errors may be classified according to level of importance by means of a weighting system. An error of, for example,

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5 skipping one medication may be weighted as considerably less significant compared with an error of leaving the stove on and leaving the apartment for several hours. Thus not only are errors recorded and plotted against continuous baselines over time in the trend analysis report of the system of the present invention, but the report is intended to contain a ranking system to reflect the potential negative impacts of different errors.

10 In addition to errors, the trend analysis report can plot deviations in behavior indicating changes in plot trend. For example, the trend analysis report can plot waking and sleeping hours and the number of times a user goes to the bathroom. While none of this in itself indicates a situation requiring intervention, 15 sudden changes in sleep habits, bathroom use, even appliance use may indicate sudden changes in health or cognitive well being requiring a relative or a case management social worker or case management social worker or a physician to visit or interview the user.

20 While any number of combinations of interpreted data can be used in any number of specialized reports, it is anticipated that most case management sites and most relatives would want to know the frequency and severity of specific errors, the extent and accuracy of medication



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compliance and whether a waking or sleeping pattern of a user is changing radically. The trend analysis report provides case managers and relatives with this information and enables them to better help the user by locating subtle changes in behavior patterns, monitoring various kinds of potentially dangerous errors and keeping a record of baseline functioning in relation to monitored activities.

While the operation of the monitoring system 100 has been described principally with respect to the monitoring of a gerontological patient, it will be understood that system 100 may be used to monitor any type of patient, for example, infants and burn victims. Additionally, it will be understood that, using the correct sensors, monitoring system 100 may monitor any parameters relevant to these patients, for example, ambient temperature, body temperature and blood pressure. In general, anything which may be sensed by a sensor and converted into an electrical signal may be monitored by the monitoring system 100. Additionally, the data could be made available to a doctor prior to routine doctor's appointments in addition to being used to compile reports at the remote monitoring site 148. The system could be

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monitored by a friend or relative rather than by  
professionals at a remote monitoring site.

It will be appreciated by those skilled in the  
art that changes could be made to the embodiment  
described above without departing from the broad  
inventive concept thereof. It is understood, therefore,  
that this invention is not limited to the particular  
embodiments disclosed, but it is intended to cover all  
modifications within the spirit and scope of the present  
invention as defined by the appended claims.

CLAIMS

1. A system for monitoring a user in a user living area, said system including a remote monitoring site, comprising:
  - a system controller;
  - an activity detection subsystem for monitoring a daily living activity of the user independently of physiological measurements, said activity detection subsystem having at least one detector device capable of being activated in response to said occurrence of said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide to the system controller information representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said daily living activity information;
  - a control information communication channel for applying said control signal to said remote monitoring site;
  - a report generator for generating a scheduled periodic reports on daily living activities, said reports having collections of said information representative of selected daily living activities;
  - a generator for generating a trend analysis in accordance with said reports of said information on said daily living activities; and
  - means for intervening in said user living area in accordance with said trend analysis.
2. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises a motion detector subsystem for detecting motion of said user.
3. The system for monitoring a user in a user living area of claim 2, further comprising a switch coupled to an object for detecting movement of said object.
4. The system for monitoring a user in a user living area of claim 3, wherein said switch comprises a reed switch connected to a door.

5. The system for monitoring a user in a user living area of claim 2, wherein said user living area comprises a bed and said motion detector subsystem is disposed within said user living area to determine whether said user is disposed in said bed.
6. The system for monitoring a user in a user living area of claim 2, wherein said system controller comprises timing means for acting cooperatively with said motion detector subsystem to determine a period of user inactivity.
7. The system for monitoring a user in a user living area of claim 6, further comprising means for determining that said period of user inactivity is longer than a predetermined time period.
8. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises a medicine compliance detection subsystem.
9. The system for monitoring a user in a user living area of claim 8, wherein said medicine compliance detector subsystem comprises:
  - a medication container for containing medication; and,
  - a medication container holder for holding said medication container, said medication container holder including means for determining whether said medication container is disposed within said medication container holder.
10. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises a water use detection subsystem.
11. The system for monitoring a user in a living area claim 10, wherein said water use detection subsystem comprises a water level detector.
12. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises an auxiliary appliance detection subsystem.

13. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises a stove use subsystem.
14. The system for monitoring a user in a user living area of claim 1, wherein said system controller comprises a multi-channel radio frequency receiver.
15. The system for monitoring a user in a user living area of claim 1, wherein said user living area is provided with a power supply line and said system controller comprises a power line transmitter for applying said control signal to said activity detection subsystem by way of said power supply line.
16. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises a controller receiver for receiving said control signal from said system controller by way of said power supply line.
17. The system for monitoring a user in a user living area of claim 1, wherein said system controller comprises voice data storage for storing voice messages and providing said voice messages to said user.
18. The system for monitoring a user in a user living area of claim 1, wherein said user living area is provided with a telephone line and said system controller applies said control signal to said remote monitoring site by way of said telephone line.
19. The system for monitoring a user in a user living area of claim 1, further comprising means for intervening in said user living area in accordance with said control information and a predetermined intervention protocol.
20. The system for monitoring a user in a user living area of claim 1, further comprising means for separating said information into priority information and standard information and immediately transferring said priority information to said remote monitoring site.

21. The system for monitoring a user in a user living area of claim 1, including a plurality of said user living areas each user living area of said plurality of user living areas being provided with a system controller and a control information communication channel and each providing information representative of a daily living activity within said user living areas of said plurality of user living areas comprising means for aggregating information supplied by said control information communication channels.

22. The system for monitoring a user in a user living area of claim 1, further comprising means for applying said control signal to said activity detection subsystem.

23. The system for monitoring a user in a user living area of claim 1, wherein said activity detection subsystem comprises means for providing information representative of said daily living activity independently of any attachments to said user.

24. A system having a power line and a plurality of user living areas for monitoring a user in said user living areas, said system including a remote monitoring site, comprising:  
a system controller and a control information communication channel providing information representative of daily living activities within the user living areas of said plurality of user living areas, each system controller including a radio frequency receiver;

an activity detection subsystem for monitoring a daily living activity of said user independently of physiological measurements, said activity detection subsystem having at least one detector device capable of being activated in response to said occurrence of said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide to the system controller information representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said daily living activity information;

a power line transmitter for applying said control signal to said subsystem by way of said power line;

a controller receiver for receiving said control signal by way of said power line;

a control information communication channel in each user living area of said plurality of user living areas for applying said control signal to said remote monitoring site;

means for aggregating information supplied by said control information control channels;  
a motion detector disposed within said user living area to detect the motion of said user and  
determine whether said user is out of a bed; and  
a timer cooperating with said motion detector for determining a period of user inactivity.

25. The system for monitoring a user in a user living area of claim 24, further comprising  
means for generating reports of said daily living activities, said reports having collections of said  
information representative of said daily living activity.

26. The system for monitoring a user in a user living area of claim 25, further comprising  
means for generating scheduled periodic reports.

27. The system for monitoring a user in a user living area of claim 26, wherein said periodic  
reports comprise information on selected daily living activities.

28. The system for monitoring a user in a user living area of claim 25, further comprising  
means for generating a trend analysis in accordance with said reports of said information on said  
daily living activities.

29. The system for monitoring a user in a user living area of claim 28, further comprising  
means for detecting changes in said trends.

30. The system for monitoring a user in a user living area of claim 25, further comprising  
means for generating summaries of said reports of said information representative of said daily  
living activity.

31. The system for monitoring a user in a user living area of claim 30, further comprising  
means for distributing said summaries.

32. The system for monitoring a user in a user living area of claim 28, further comprising  
means for intervening in said user living area in accordance with said trend analysis.

33. A system having a power line and a plurality of user living areas for monitoring a user in said user living areas, said system including a remote monitoring site, comprising:
- a system controller and a control information communication channel providing information representative of daily living activities within the user living areas of said plurality of user living areas, each system controller including a radio frequency receiver;
  - an activity detection subsystem for monitoring a daily living activity said user independently of physiological measurements, said activity detection subsystem having at least one detector device capable of being activated in response to said occurrence or said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide to the system controller information representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said daily living activity information;
  - a power line transmitter for applying said control signal to said subsystem by way of said power line;
  - a controller receiver for receiving said control signal by way of said power line;
  - a control information communication channel in each user living area of said plurality of user living areas for applying said control signal to said remote monitoring site; and
  - said activity detection subsystem including a water use detection subsystem.
34. The system for monitoring a user in a user living area of claim 33, further comprising a report generator for generating reports of said daily living activities, said reports having collections of said information representative of said daily living activity.
35. The system for monitoring a user in a user living area of claim 34, further comprising means for generating scheduled periodic reports.
36. The system for monitoring a user in a user living areas of claim 35, wherein said periodic reports include information on selected daily living activities.



37. The system for monitoring a user in a user living area of claim 34, further comprising means for generating a trend analysis in accordance with said reports of said information on said daily living activities.
38. The system for monitoring a user in a user living area of claim 37, further comprising means for detecting changes in said trends.
39. The system for monitoring a user in a user living area of claim 34, further comprising means for generating summaries of said reports of said information representative of said daily living activity.
40. The system for monitoring a user in a user living area of claim 39; further comprising means for distributing said summaries.
41. The system for monitoring a user in a user living area of claim 33, comprising means for intervening in said user living area in accordance with said control information and a predetermined intervention protocol.
42. The system for monitoring a user in a user living area of claim 33, further comprising means for separating said information into priority information and standard information and immediately transferring said priority information to said remote monitoring site.
43. The system for monitoring a user in a user living area of claim 37, further comprising means for intervening in said user living area in accordance with said trend analysis.
44. A system having a power line and a plurality of user living areas for monitoring a user in said user living areas, said system including a remote monitoring site, comprising:  
a system controller and a control information communication channel providing information representative of daily living activities within the user living areas of said plurality of user living areas, each system controller including a radio frequency receiver;

an activity detection subsystem for monitoring a daily living activity of said user independently of physiological measurements, said activity detection subsystem having at least one detector device capable of being activated in response to said occurrence of said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide to the system controller information representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said daily living activity information;

a power line transmitter for applying said control signal to said subsystem by way of said power line;

a controller receiver for receiving said control signal by way of said power line;

a control informational communication channel in each user living area of said plurality of user living areas for applying said control signal to said remote monitoring site; and

said activity detection subsystem including a stove use subsystem.

45. The system for monitoring a user in a user living area of claim 44, further comprising a report generator for generating reports of said daily living activities, said reports having collections of said information representative of said daily living activity.

46. The system for monitoring a user in a user living area of claim 45, further comprising means for generating scheduled periodic reports.

47. The system for monitoring a user in a user living area of claim 46, wherein said periodic reports include information of selected daily living activities.

48. The system for monitoring a user in a user living area of claim 45, further comprising means for generating a trend analysis in accordance with said reports of said information of said daily living activities.

49. The system for monitoring a user in a user living area of claim 48, further comprising means for detecting changes in said trends.

50. The system for monitoring a user in a user living area of claim 45, further comprising means for generating summaries of said reports of said information representative of said daily living activity.
51. The system for monitoring a user in a user living area of claim 50, further comprising means for distributing said summaries.
52. The system for monitoring a user in a user living area of claim 44, comprising means for intervening in said user living area in accordance with said control information and a predetermined intervention protocol.
53. The system for monitoring a user in a user living area of claim 44, further comprising means for separating said information into priority information and standard information and immediately transferring said priority information to said remote monitoring site.
54. The system for monitoring a user in a user living area of claim 48, further comprising means for intervening in said user living area in accordance with said trend analysis.
55. A system for monitoring a user in a user living area, said system including a remote monitoring site comprising:
- a system controller;
  - an activity detection subsystem for monitoring a daily living activity of said user independently of physiological measurements, said activity detection subsystem having at least one detector device capable of being activated in response to an occurrence of said daily living activity and capable of determining at said user living area that said daily activity has occurred to provide information to said system controller representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said information representative of said daily living activity;
  - a control information communication channel for applying said control signal to said remote monitoring site;

a report generator for generating a schedule periodic report on said daily living activity, said report having collections of said information representative of selected daily living activity; and

circuitry for intervening in said user living area in accordance with said\_scheduled periodic report.

56. The system for claim 55, wherein said activity detection subsystem comprises a detector for determining food preparation.

57. The system of claim 55, wherein said activity detection subsystem comprises a detector for determining a user bath.

58. A system of claim 55, wherein said activity detection subsystem comprises a detector for determining whether said user is out of bed.

59. The system of claim 55, wherein said activity detection subsystem comprises a medication management system for determining medication use.

60. A system for monitoring a user in a user living area, said system including a remote monitoring site, comprising:

a system controller;

an activity detection subsystem for monitoring a daily living activity of the user independently of physiological measurements, said activity detection subsystem having at least one detector device capable of being activated in response to an occurrence of said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide information to said system controller representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said information representative of said daily living activity;

a control information communication channel for applying said control signal to said remote monitoring site;

a generator for generating a trend analysis in accordance with said determined daily living activity; and

circuitry for intervening in said user living area in accordance with said trend analysis.

61. A system for monitoring a user in a living area, said system including a remote monitoring site, comprising:

a programmable system controller;

a programming device disposed at the remote monitoring site for programming said programmable system controller;

an activity detection subsystem for monitoring a daily living activity of the user, said activity detection subsystem having at least one detector device capable of being activated in response to said occurrence of said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide the programmable system controller information representative of said daily activity, said programmable system controller having a control circuit for generating a control signal in response to said daily living activity information representative of said daily living activity and according to said programming;

a control information communication channel for applying said control signal to said remote monitoring site in accordance with said remotely programmed system controller; and

circuitry for intervening in said user living area in accordance with said daily living activity information representative of said daily living activity.

62. A system for monitoring a user in a user living area, said system including a remote monitoring site, comprising:

a system controller;

a plurality of activity detection subsystem for monitoring a corresponding plurality of differing daily living activities of said user, said activity detection subsystem each having a least one detector device capable of being activated in response to occurrences of said daily living activities and capable of determining at said user living area that said daily living activities have occurred to provide information to said system controller information representative of said daily living activities, said system controller having a control circuit for generating control signals in response to the occurrence of the daily living activities as determined by the activity detection

subsystems and providing control information in accordance with a plurality of said control signals;

a control information communication channel for applying said control signals to said remote monitoring site; and

circuitry for intervening in said user living area in accordance with said control information.

63. A method for monitoring a user in a user living area, in a system including a remote monitoring site, comprising the steps of:

(a) programming from the remote monitoring site a system controller located at the user living area to perform first monitoring operations;

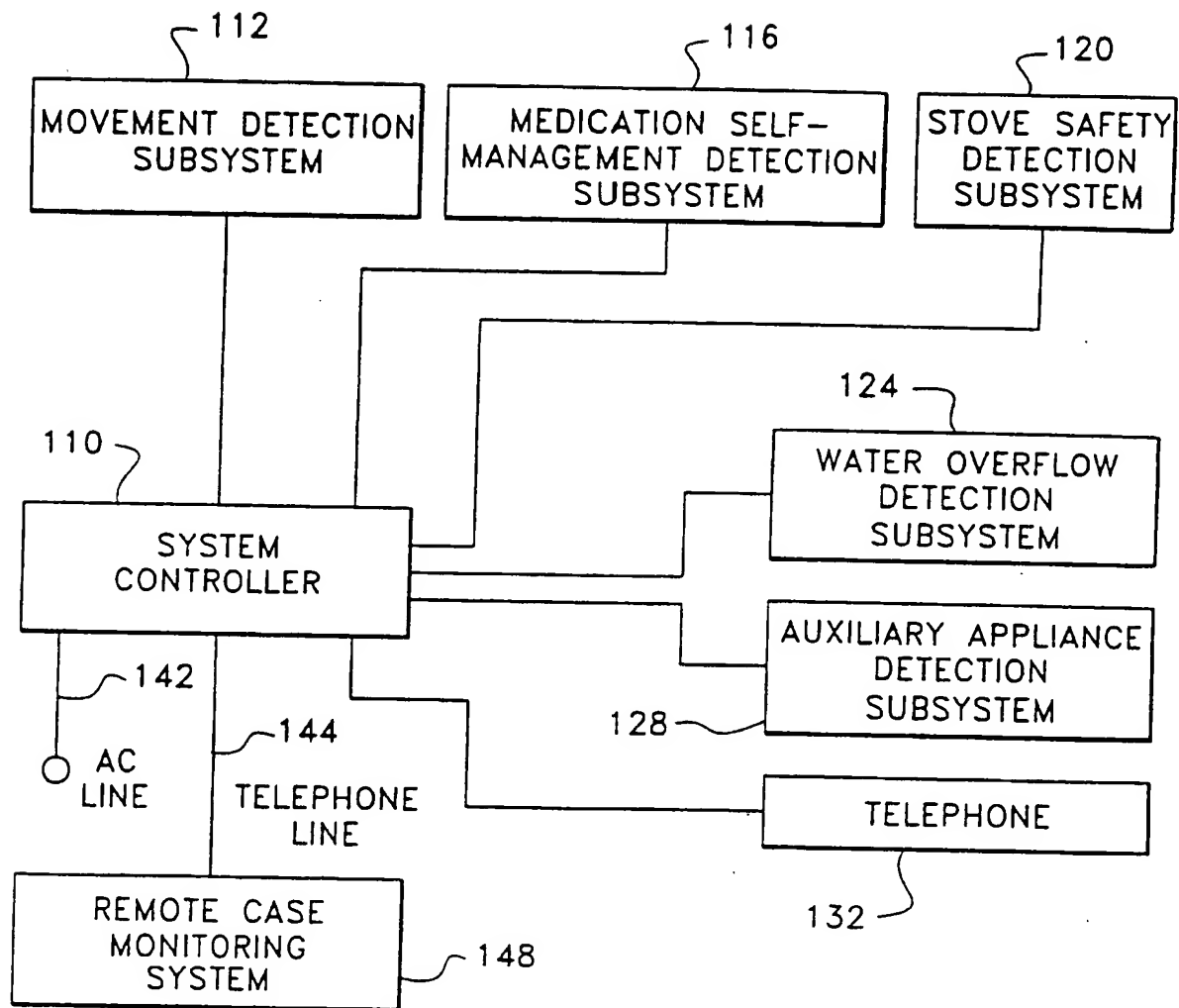
(b) said first monitoring operations including monitoring a daily living activity of said user by said programmed system controller using an activity detection subsystem having a least one detector device capable of being activated in response to an occurrence of said daily living activity and capable of determining at said user living area that said daily living activity has occurred to provide to the system controller information representative of said daily living activity, said system controller having a control circuit for generating a control signal in response to said information representative of said daily living activity, comprising the steps of:

(c) applying said control signal to said control remote monitoring site by way of a communication channel in accordance with said first monitoring operations;

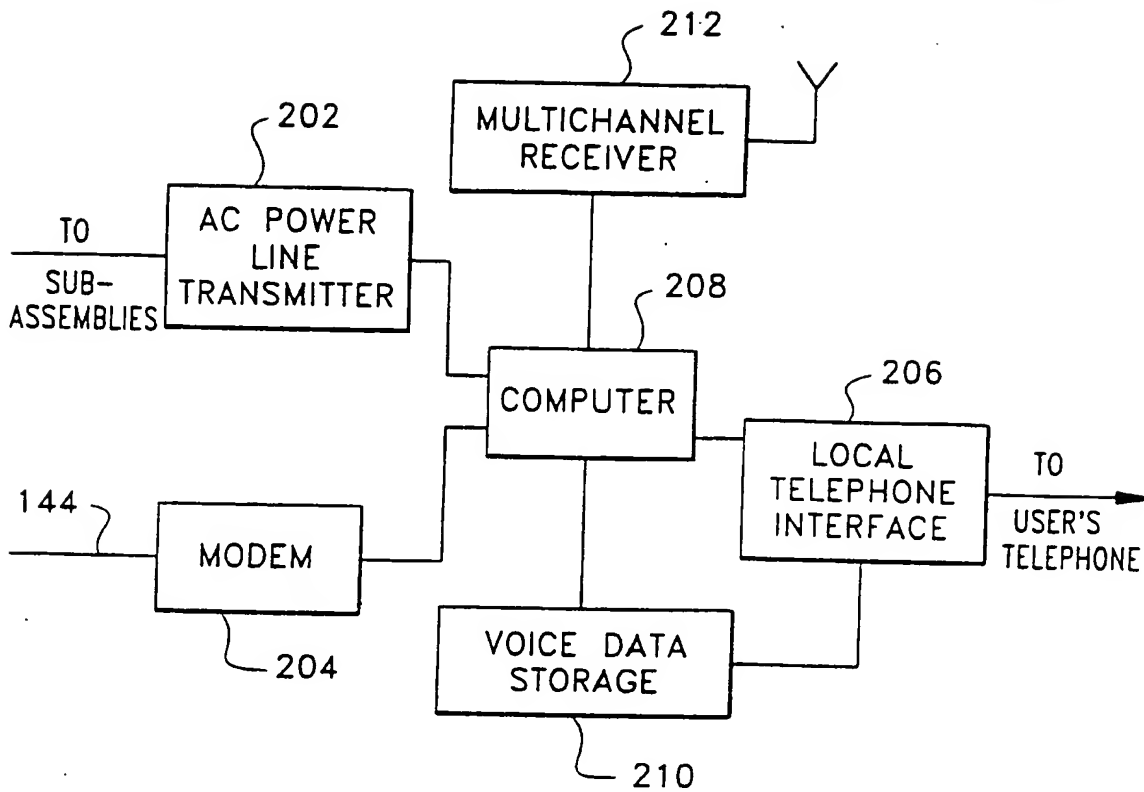
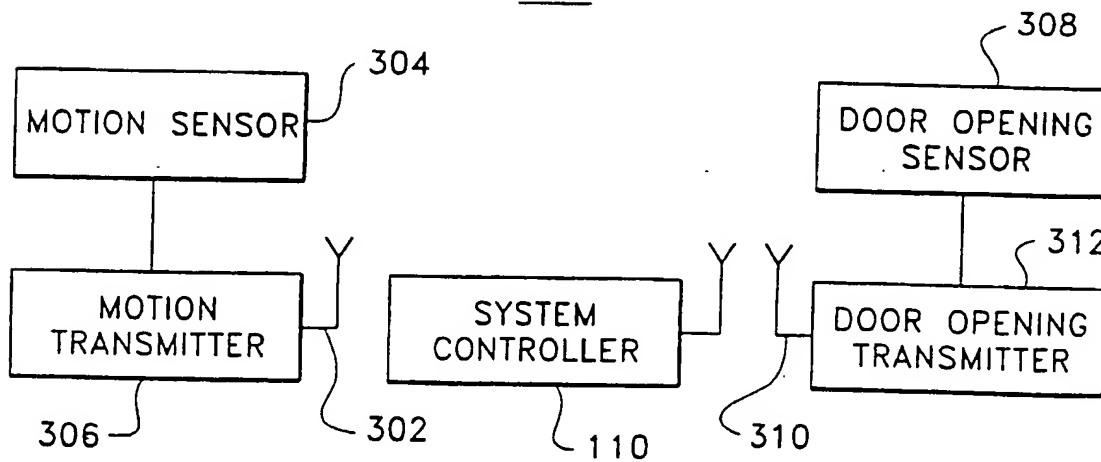
(d) reprogramming from the remote monitoring site the system controller to perform second monitoring operations to determine at said user site that a daily living activity has occurred; and

(e) applying a further control signal to said remote monitoring site by way of the communication channel in accordance with said second monitoring operations.

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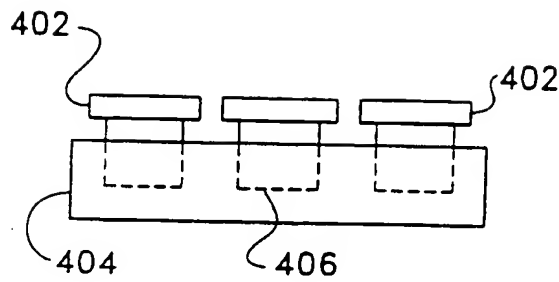
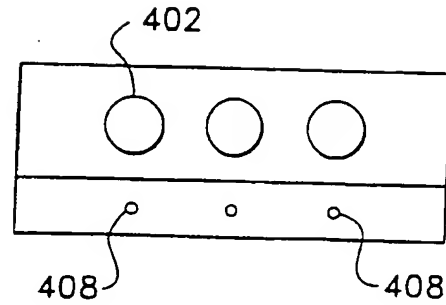
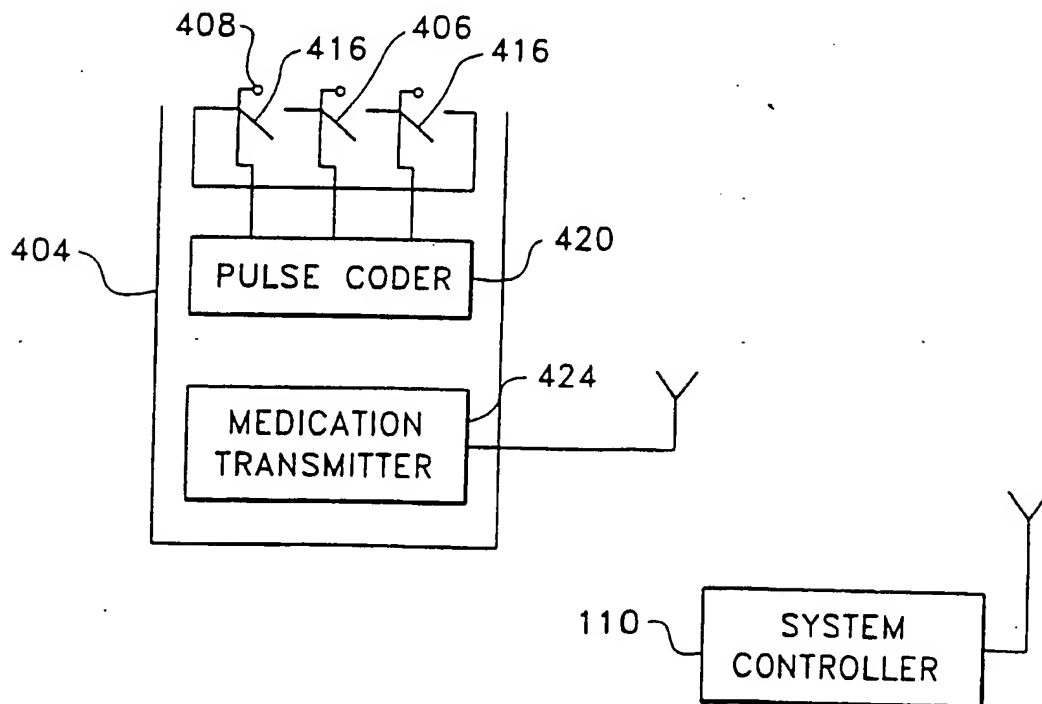
100*FIG. 1*

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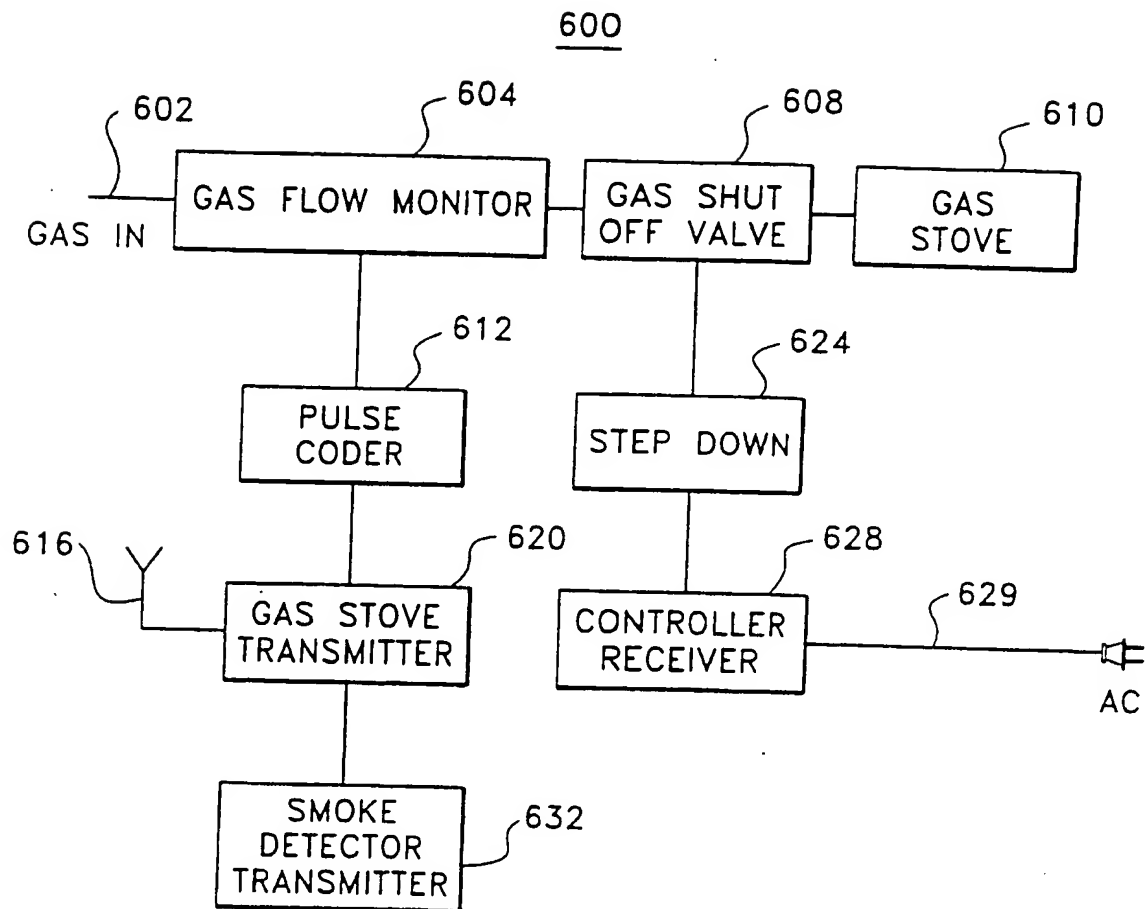
110*FIG. 2*112*FIG. 3*  
SUBSTITUTE SHEET (RULE 26)



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116*FIG. 4A**FIG. 4B*115*FIG. 5*

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*FIG. 6*

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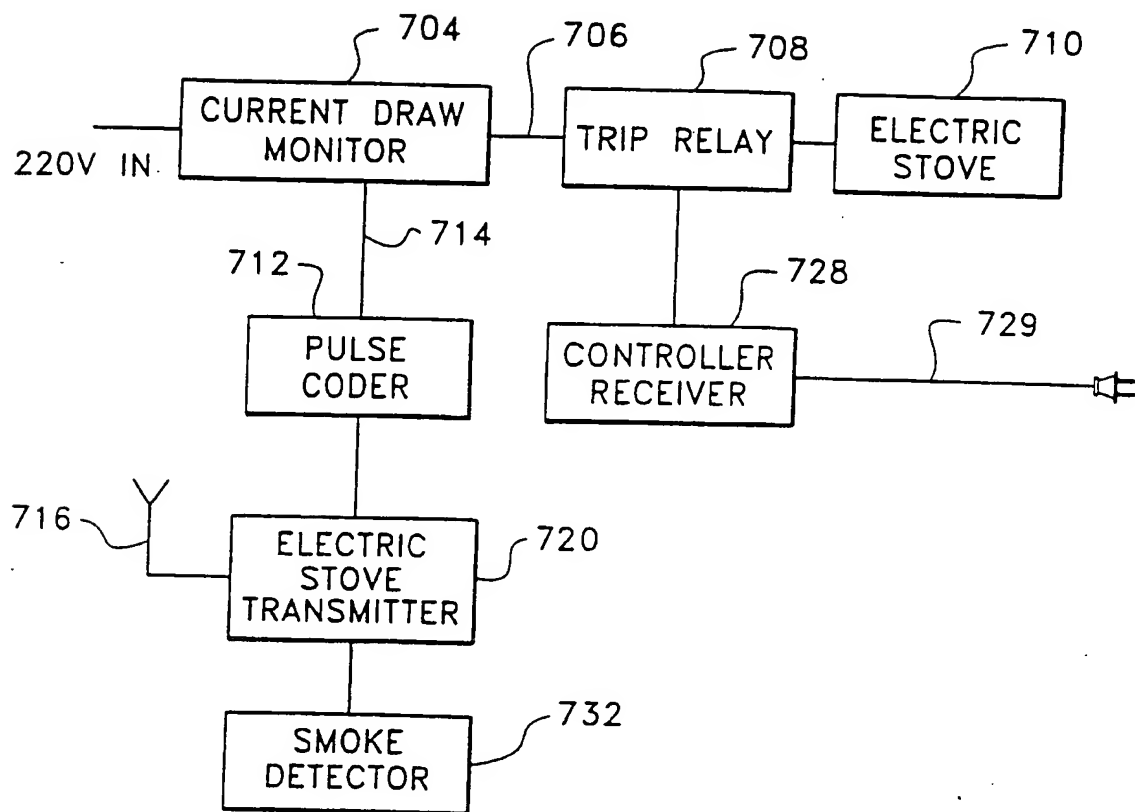
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FIG. 7

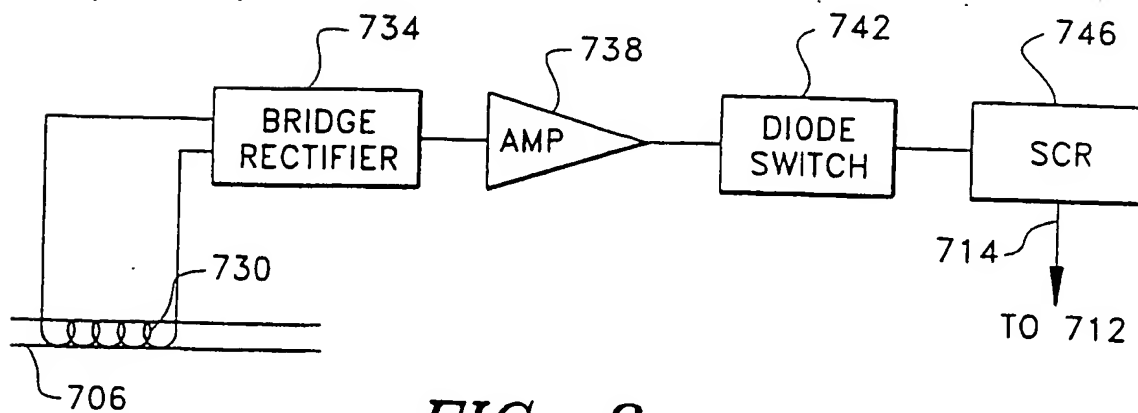
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FIG. 8

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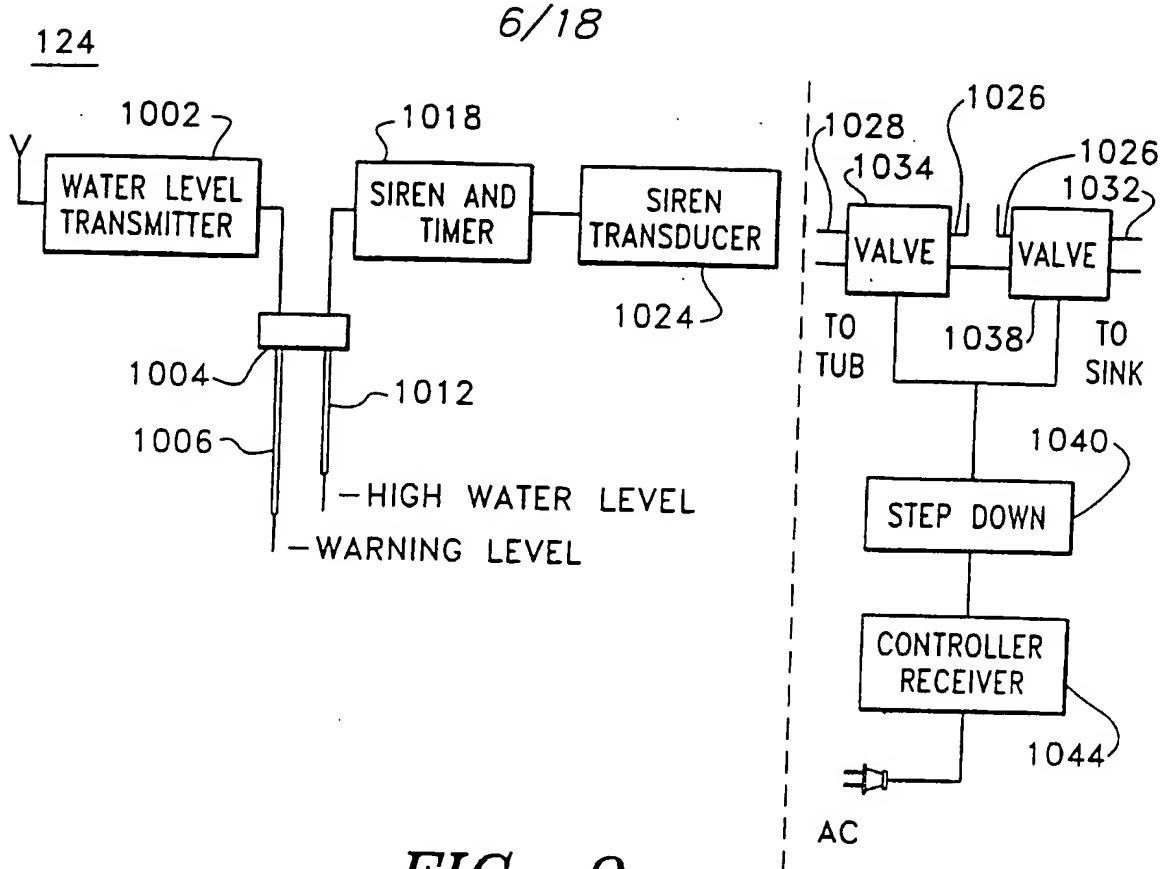


FIG. 9

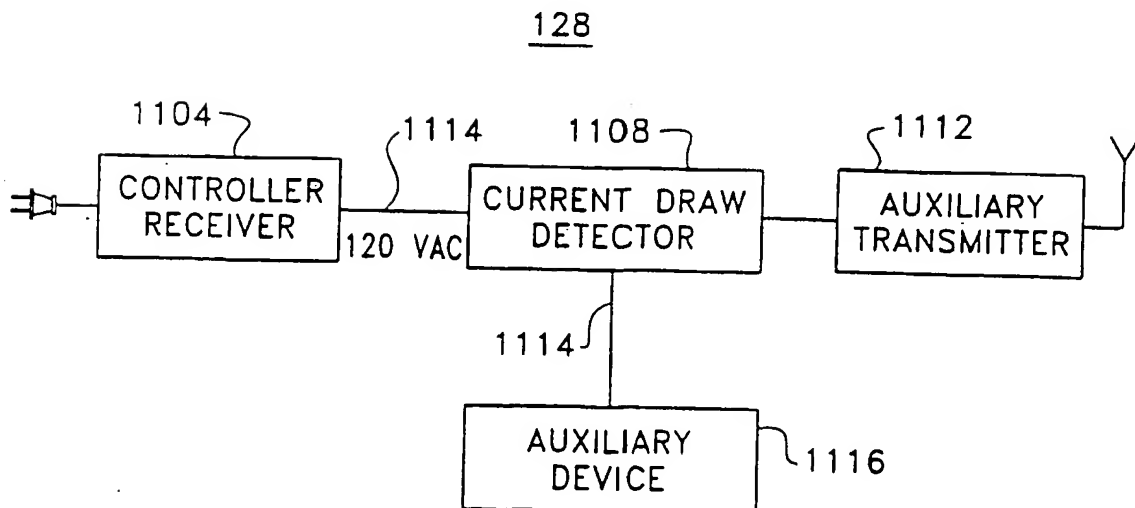
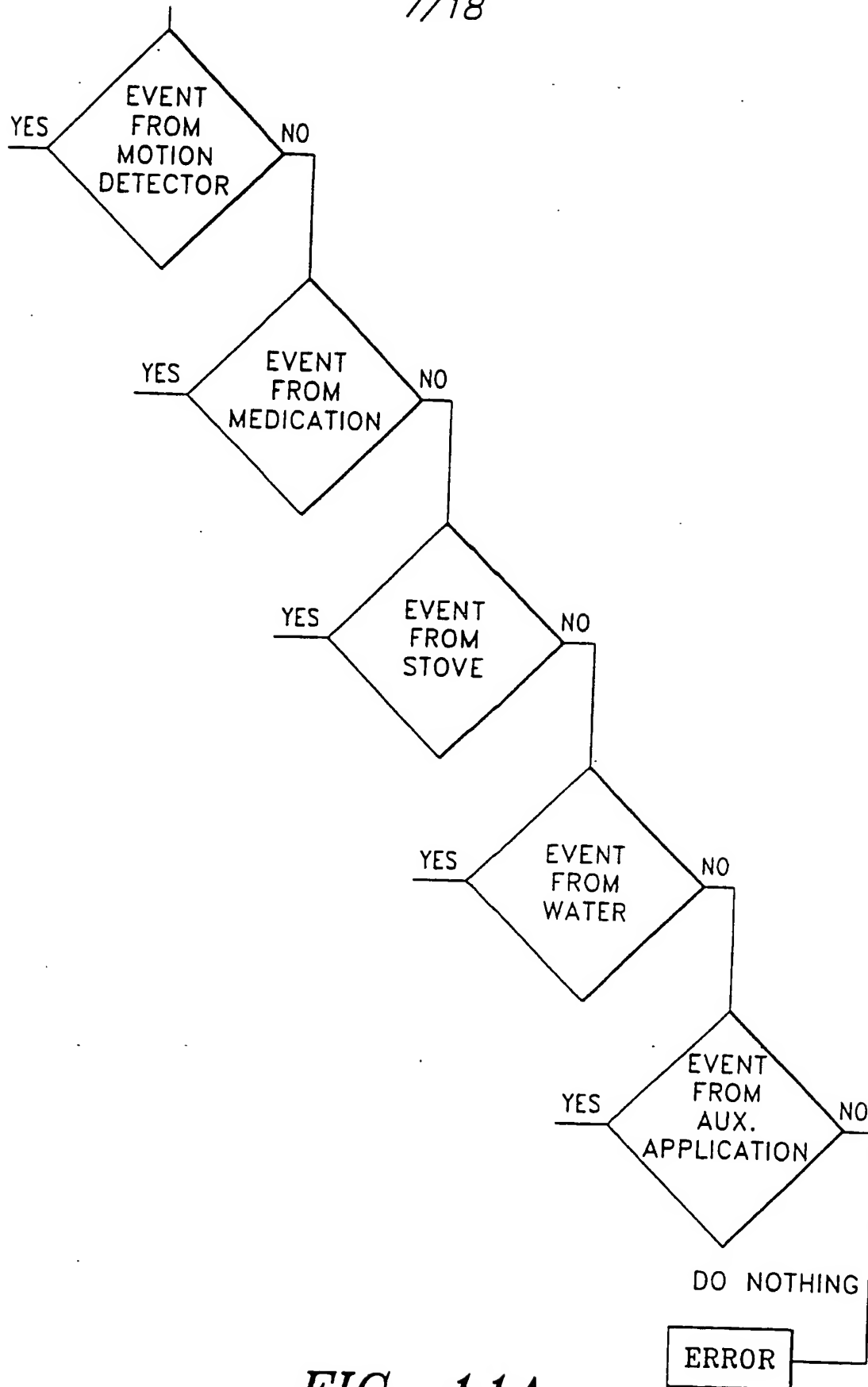


FIG. 10

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**FIG. 11A**  
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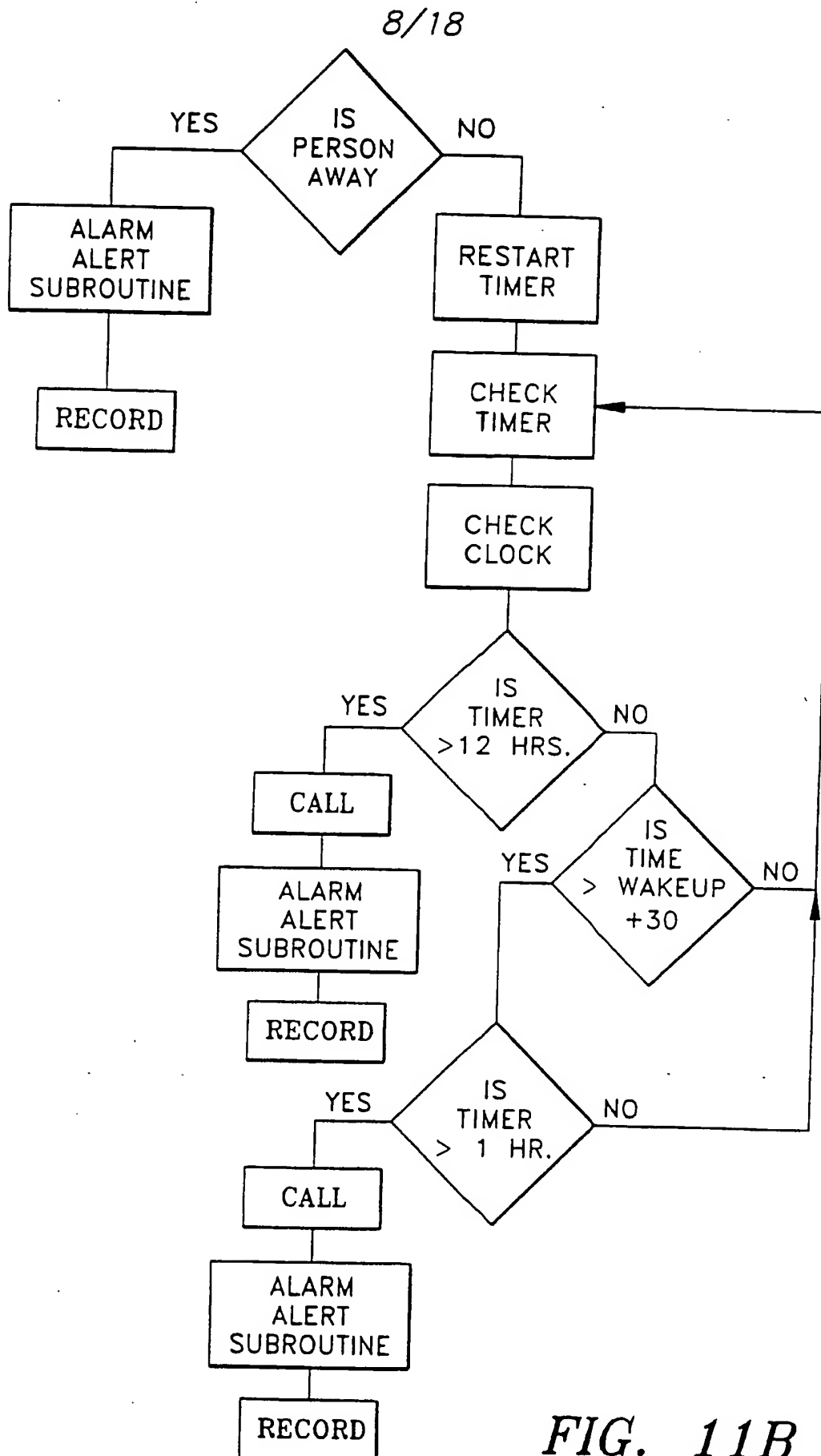


FIG. 11B

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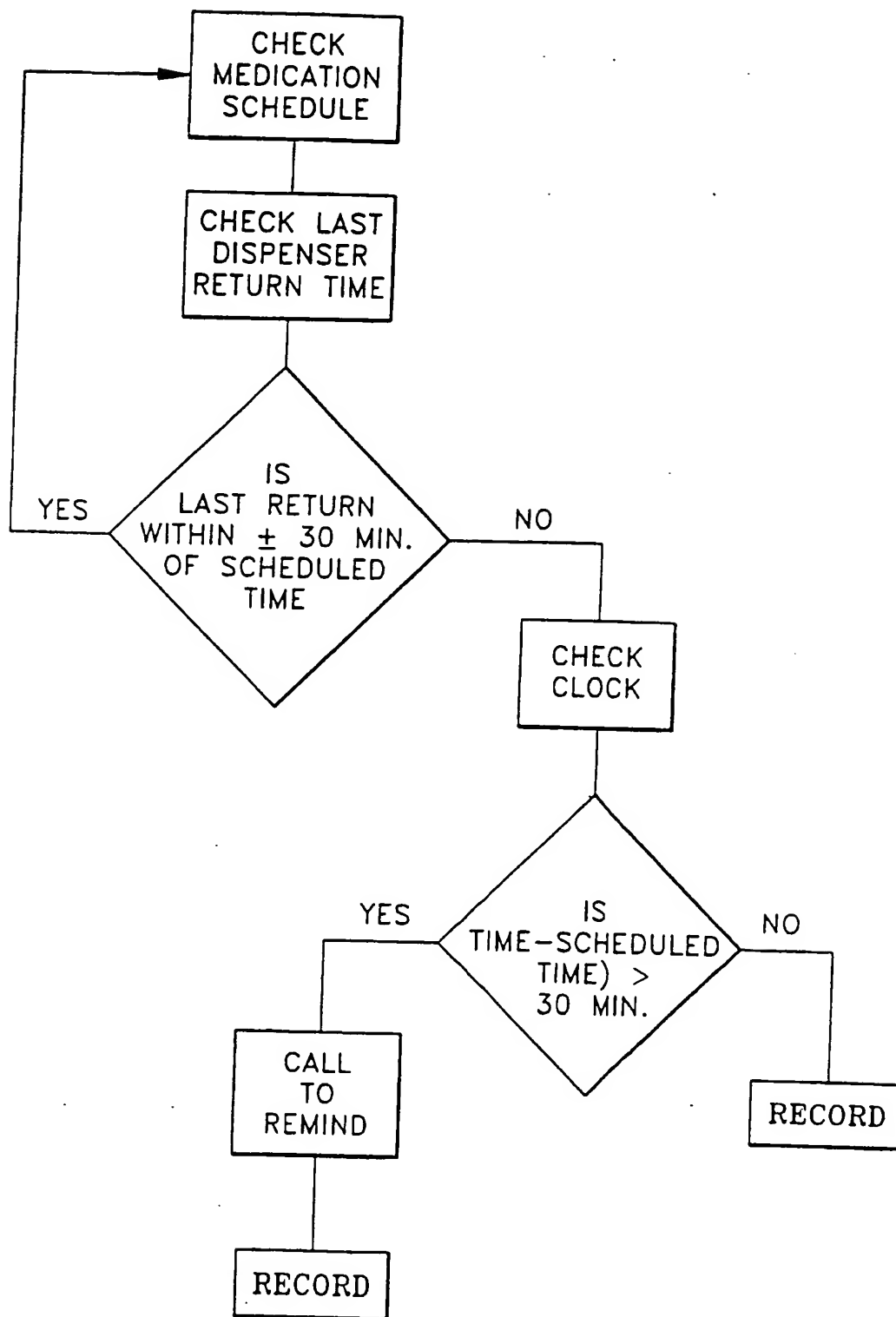


FIG. 11C

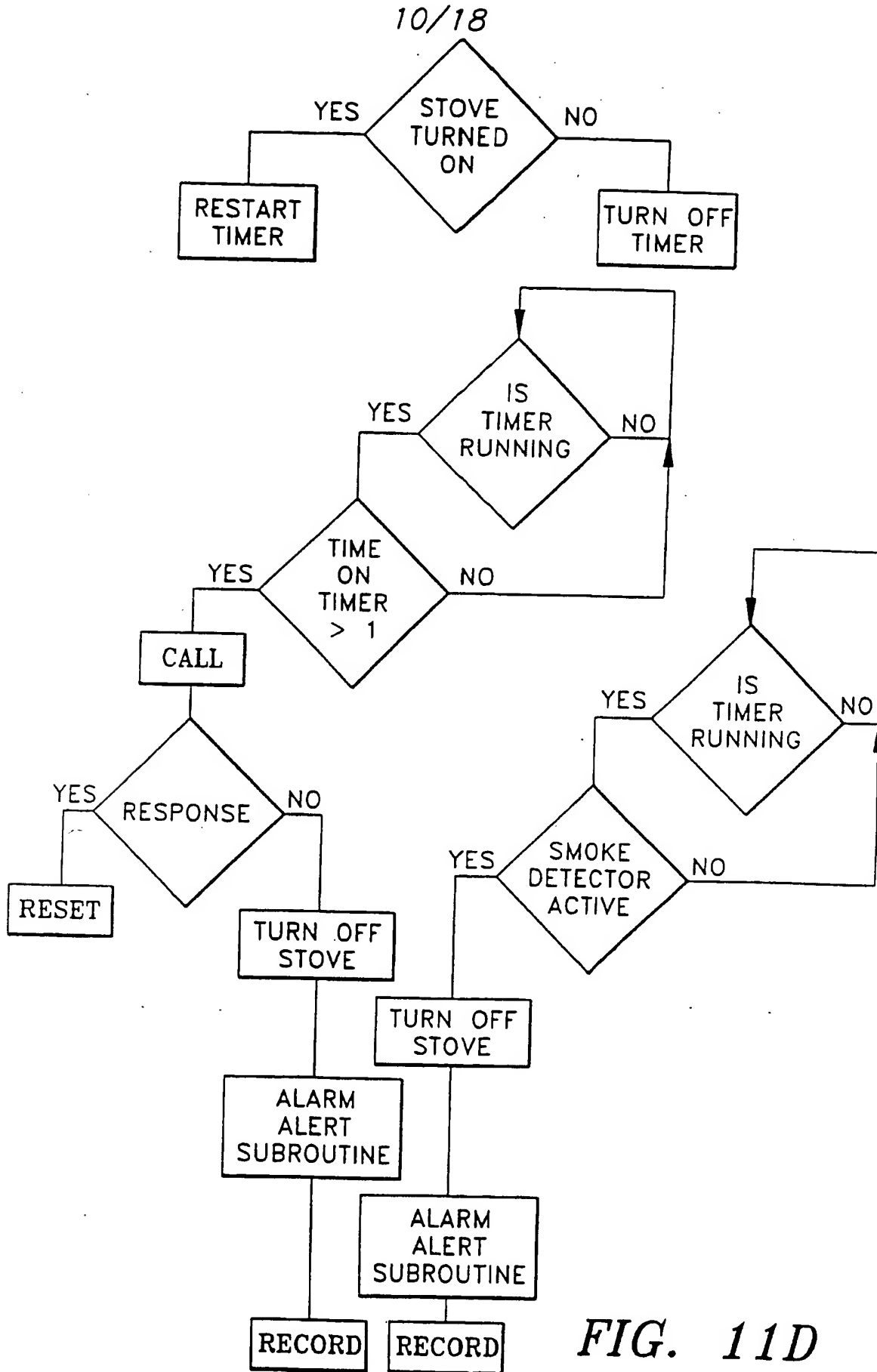
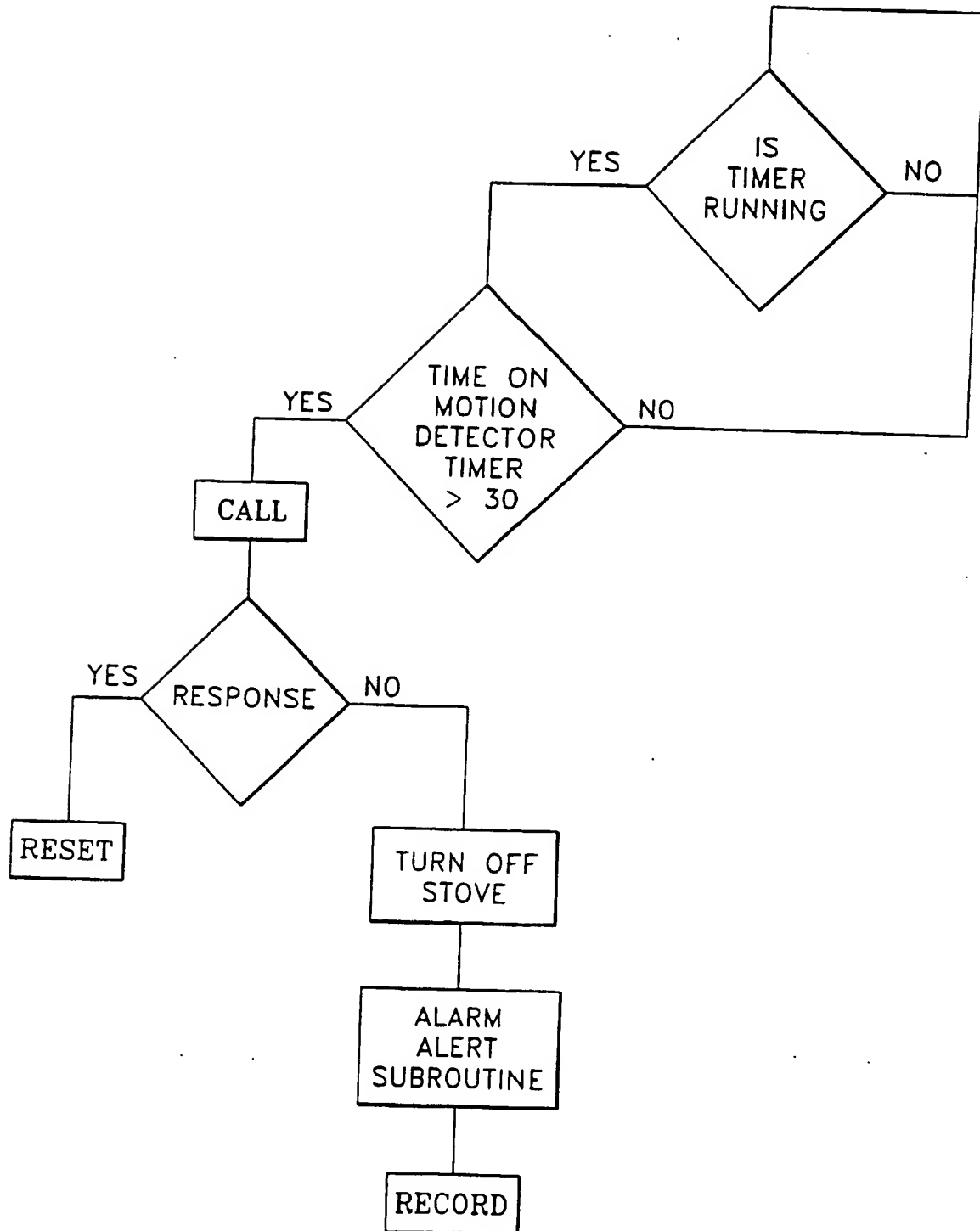


FIG. 11D

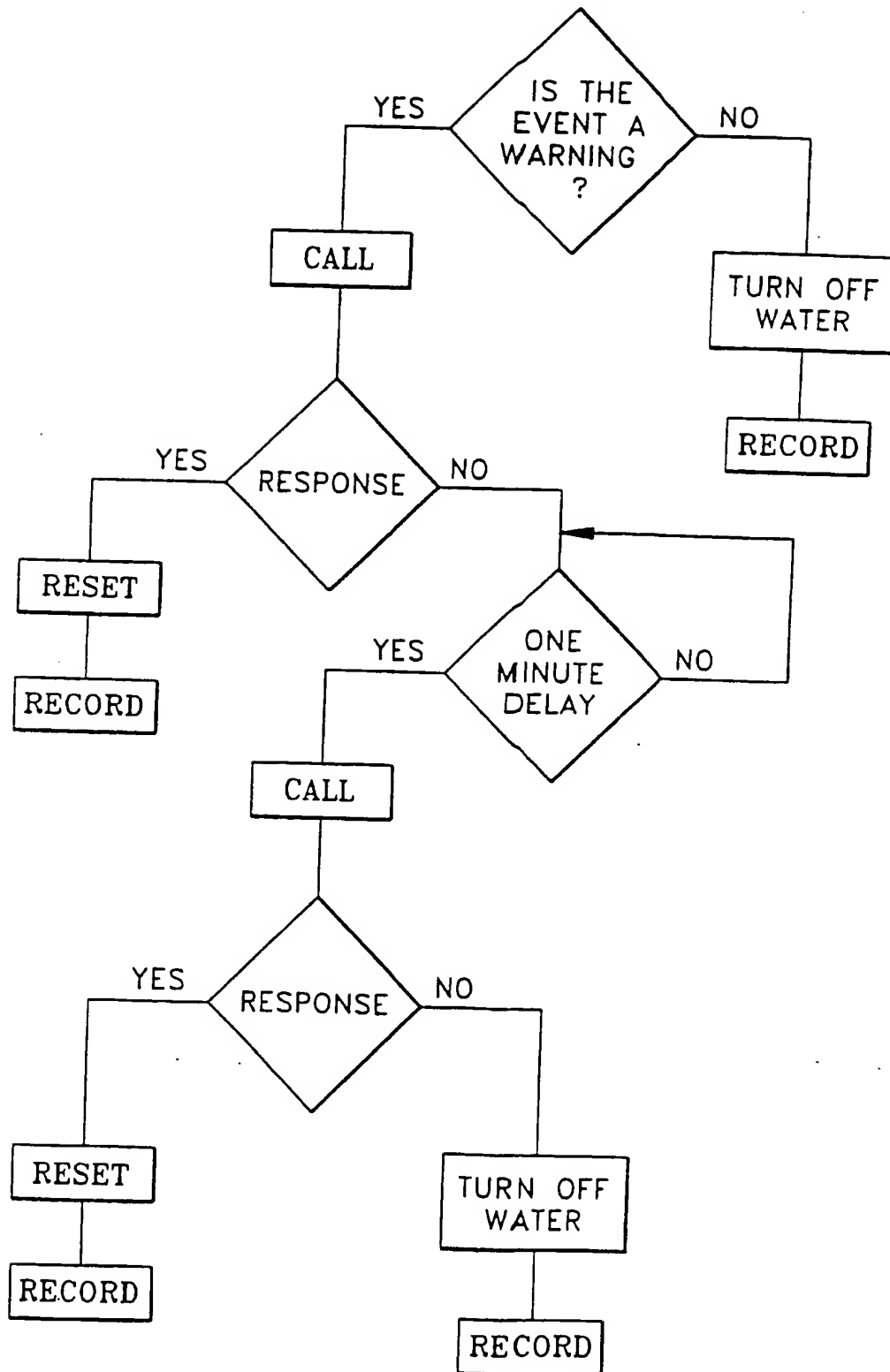


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**FIG. 11E**  
SUBSTITUTE SHEET (RULE 26)

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**FIG. 11F**  
SUBSTITUTE SHEET (RULE 26)

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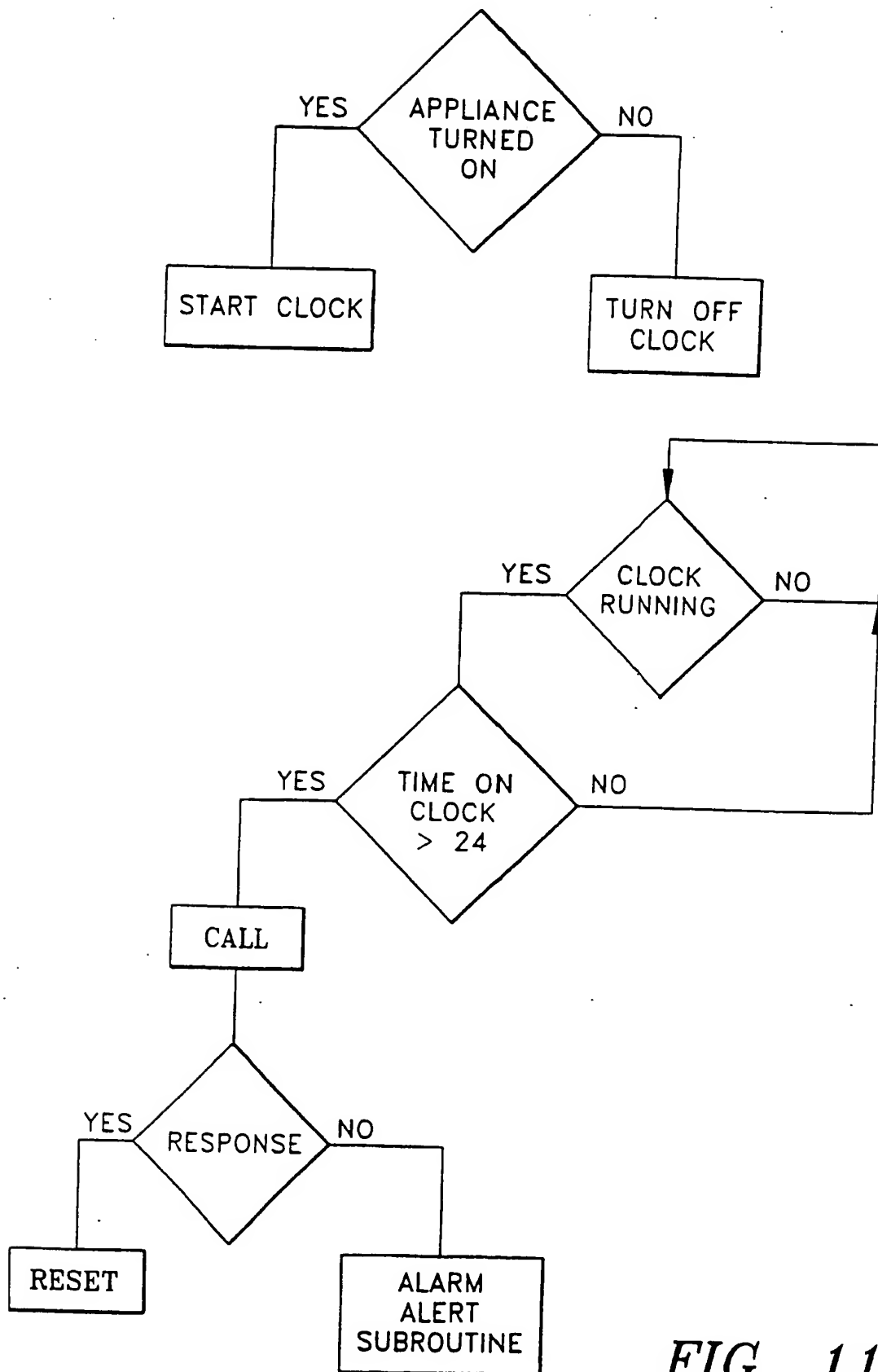
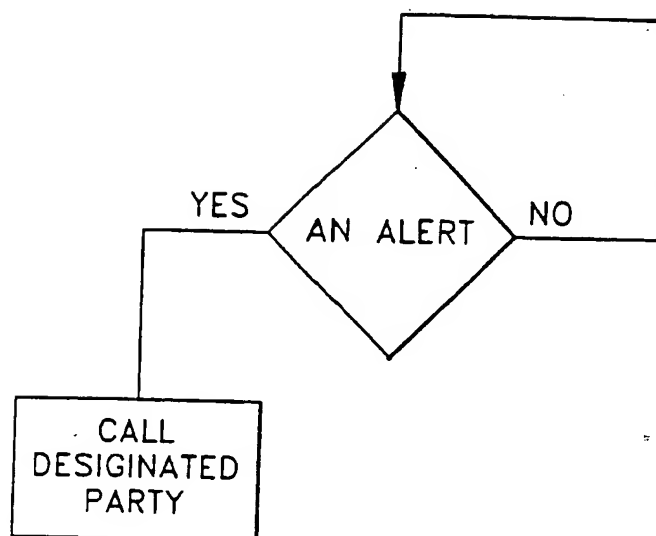
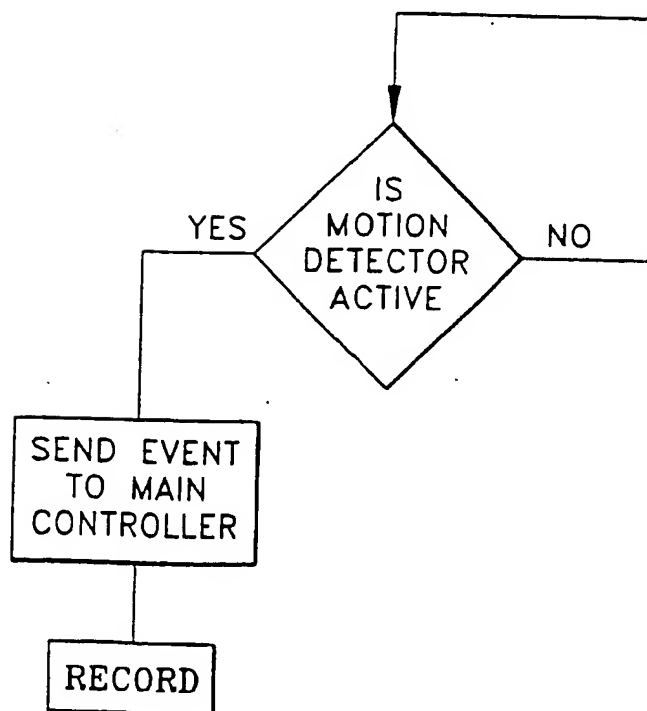


FIG. 11G

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*FIG. 11H**FIG. 11I*

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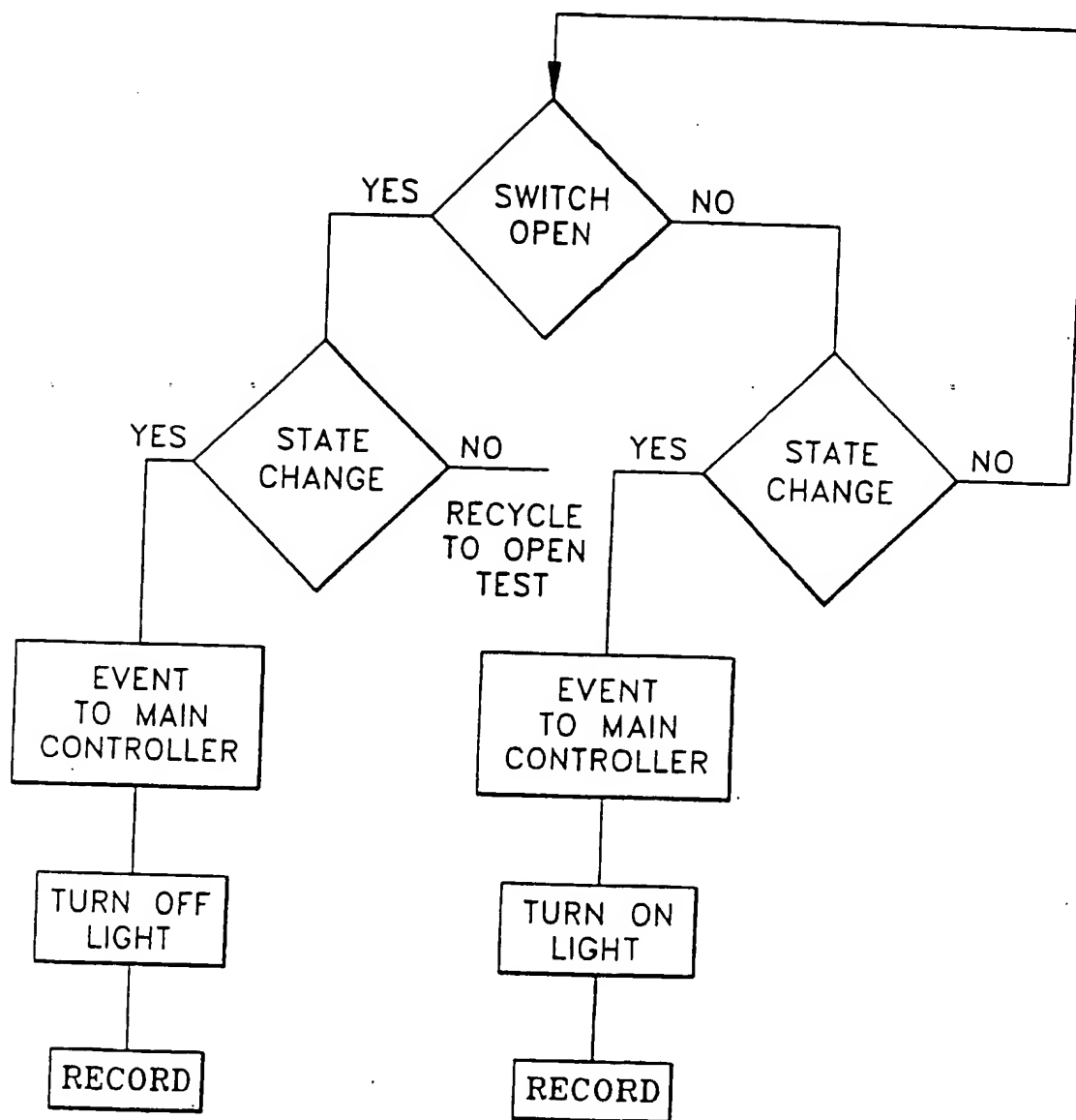


FIG. 11J

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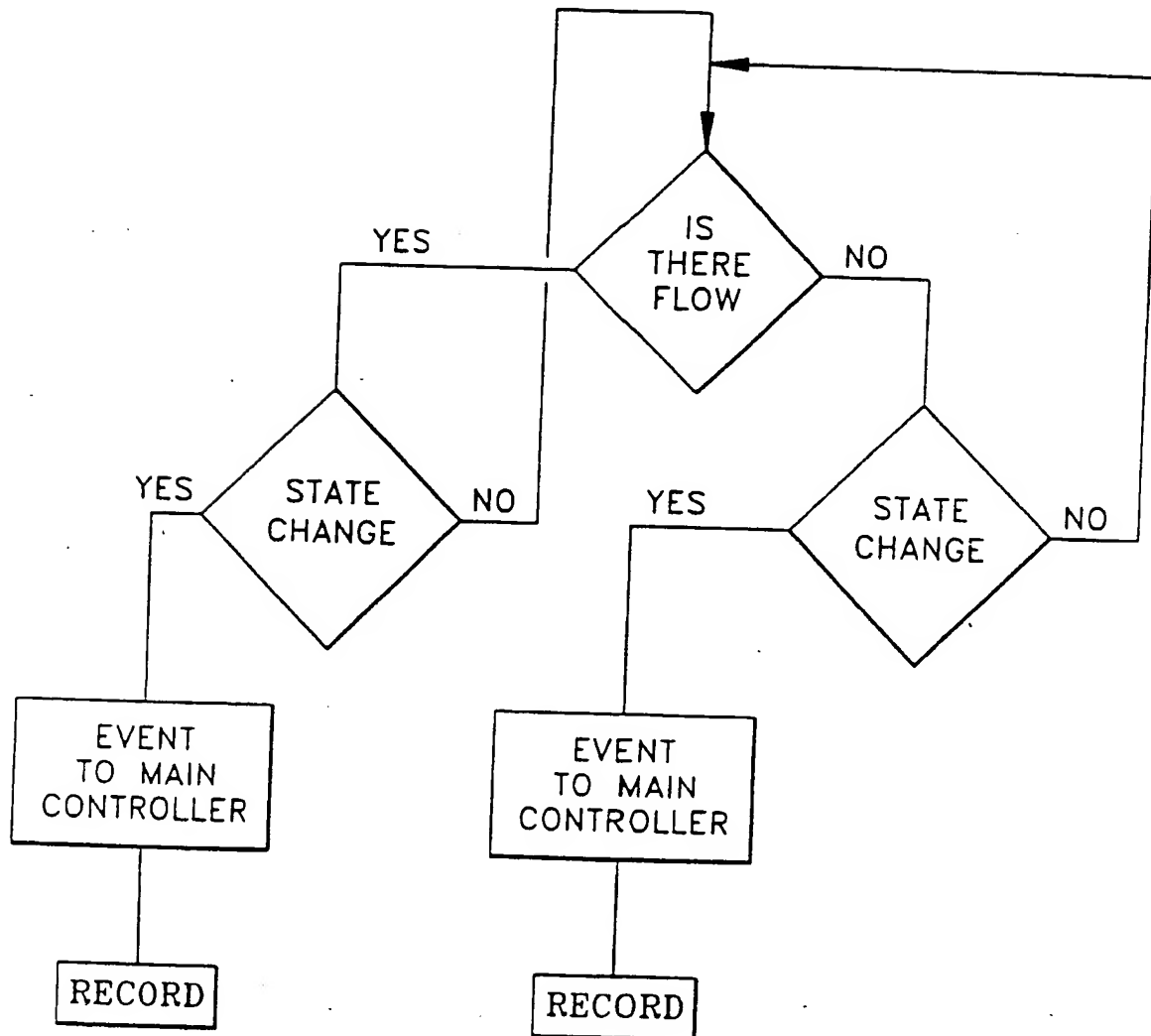
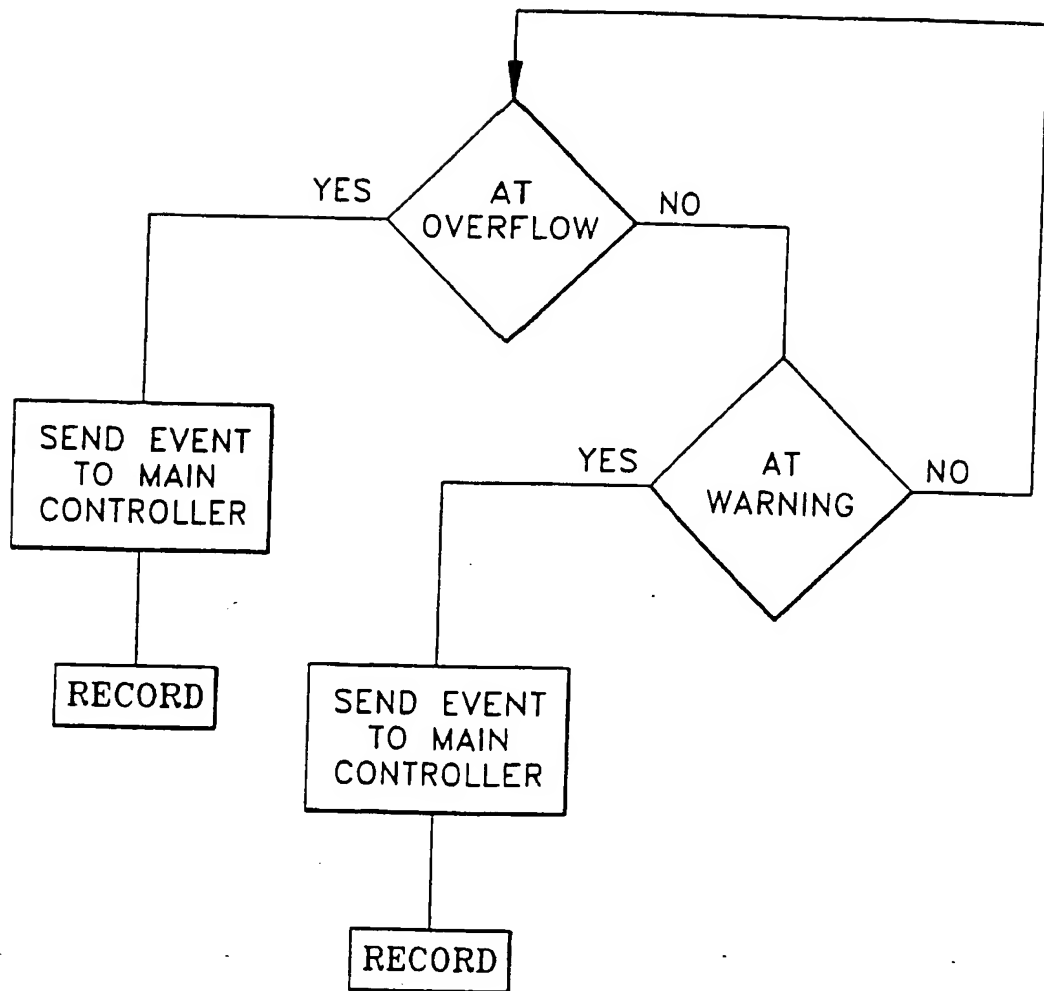


FIG. 11K

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*FIG. 11L*

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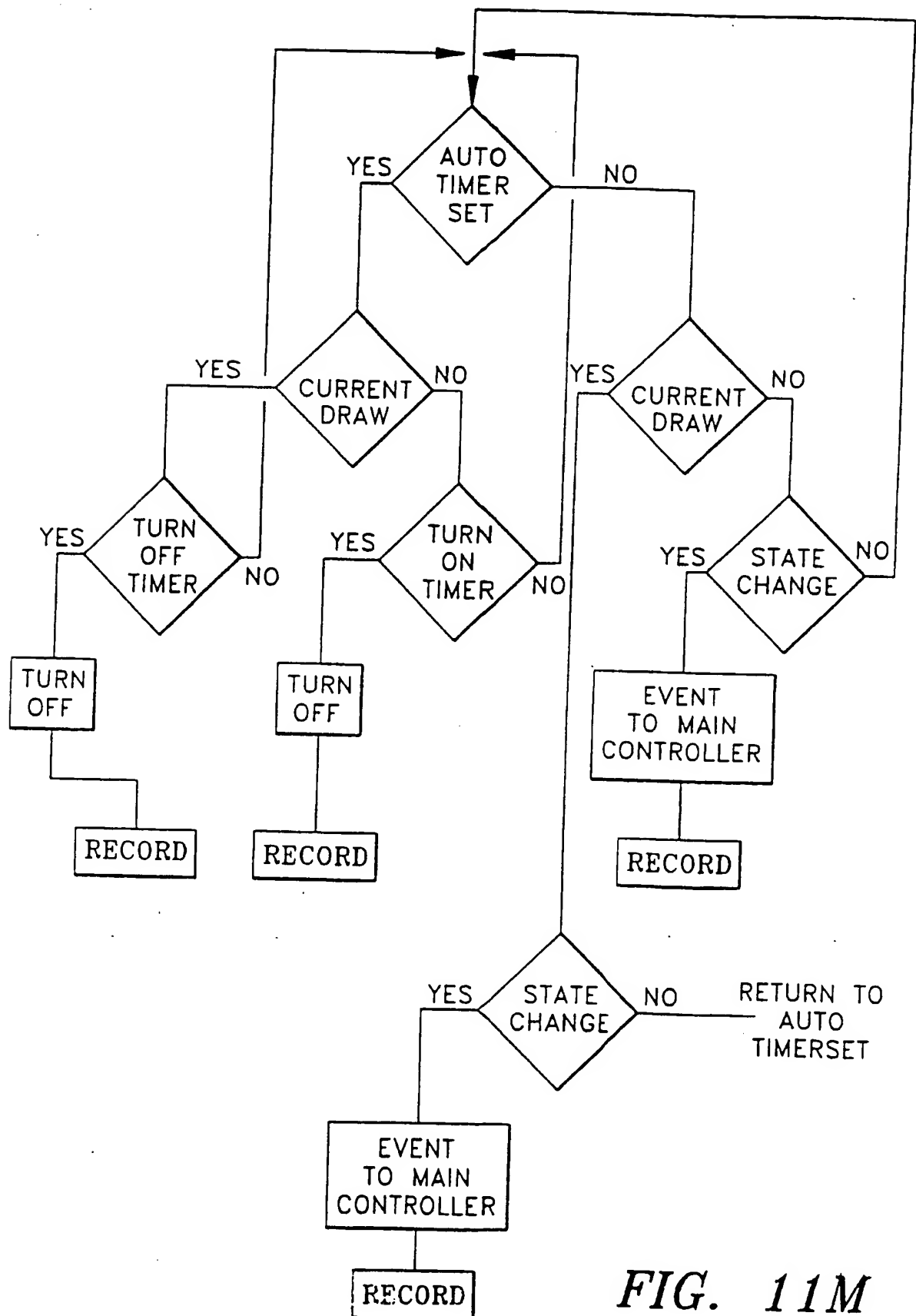


FIG. 11M



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